Mammography screening in average risk women: 25-year follow-up in the Canadian National Breast Screening Study

Towards a Rebalancing of Mammography's Harms and Benefits

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The impact of screening mammography: the debate goes on

The ever-more ferocious debate about the value of screening mammography, or at least its true impact on breast cancer mortality, shows no signs of abating. The latest salvo comes in the form of a very recent paper from Archie Bleyer (Bleyer A, Baines C, Miller AB. Impact of screening mammography on breast cancer mortality Int J Cancer: 2016 Apr 15;138:2003). Given the conviction of the message in the previous papers from this group, it is not surprising that the basic message in this recent paper remains the unchanged, namely that on a purely statistical or epidemiological basis there are no grounds for believing that the undoubted decline in breast cancer mortality in Europe and North America is due to the impact of screening mammography. This time Bleyer examines the statistics of the problem from three different approaches. Firstly they studied the chronological aspect, i.e. the temporal relationship of the onset of the decline in breast cancer mortality with the implementation in various countries of screening mammography. Secondly, they examined the magnitude of any effect, that is the degree to which breast cancer mortality declined relative to the amount (penetration) of screening mammography. Finally they used an approach by “analogy”, where they examined the pattern of mortality rate reductions of other cancer for which population screening is not conducted. This last approach simply points out that breast cancer is not the only cancer where there has been a distinct onset and thereafter a steady decline in national mortality. While in the United States there are three screened cancers in which there has been a decline in mortality that is temporally related to national screening activity, namely colon, breast and prostate cancers, there are no fewer than 14 other cancers which apparently have shown a similar distinct onset of decline in their mortality rate and for which there was no screening. These are cancer of the lung, esophagus, kidney, skin, larynx, uterus, small intestine, pleura, other oral cavities and pharynx, brain tumors, non-Hodgkin lymphoma, chronic lymphocytic leukemia, myeloma and chronic myelogenous leukemia. Bleyer’s analysis of all these statistics concludes that the distinct onset of the national mortality reduction for breast cancer is similar to the mortality profile of many other common cancers for which screening is not performed. As for the other approaches, namely chronology and magnitude, the overall conclusion is the same — an analysis of eight European and North American countries does not show a correlation between the penetration of national screening and either the chronology or magnitude of national breast cancer mortality reduction.

Bleyer concludes that taken together all these lines of evidence do not support the hypothesis that mammography screening is a primary reason for the decline in breast cancer mortality. The details of the statistical analyses supporting this conclusion are made available. Although it is never overtly stated the implication is that if there is no benefit then why continue with screening mammography which from the ionizing radiation point of view, does have a risk, albeit small.

And yet... the reality is that there are still many women who are dying of breast cancer. It is not much consolation to a woman in whom a suspicious lesion has been discovered, to tell her that statistically speaking the process that identified the lesion, that is screening mammography, itself is not justified. As Dr Costanza points out (p18 of this issue of DI Europe) the harms of not screening must also be carefully considered. What is needed is a rebalancing of mammography’s harms and benefits.
COVER STORY

mpMRI AND PROSTATE CANCER
Standardised image acquisition and comprehensive automated analysis of multi-parametric Magnetic Resonance Imaging (mpMRI) are crucial in prostate cancer for optimal diagnosis and therapy and improving patient outcome

By Dr Diana Roettger, Rado Andrian & Dr Olga Kubassova

REPORTS

A MINI-REVIEW OF THE MALMÖ BREAST TOMOSYNTHESIS SCREENING TRIAL
Page 22

OVERCOMING WORKFLOW INEFFICIENCIES WITH A SINGLE, INTEGRATED ADVANCED VISUALIZATION PLATFORM
Page 38

PRE-HOSPITAL STROKE CARE: FROM PORTABLE CES TO MOBILE THROMBOLYSIS
Page 56

FEATURE ARTICLES

Mammography screening in average risk women: 25-year follow-up in the CNBS Study
Page 16

How Harmful is Screening Mammography in 2016?
Page 18

Biopsing Areas Only Seen — or Better Seen — with Breast Tomosynthesis
Page 26

Decisions, decisions: choosing a CVIS
Page 42

Sustainable, Healthy, and High-Quality Overnight Radiology Coverage
Page 47

Image Enhancement and Dose Reduction in Interventional Radiology
Page 50

Radiology evolves with the ecosystem of enterprise imaging
Page 52

Accumulation and Toxicity of GBCAs in the Brain
Page 61

A center for fetal care with a high reputation
Page 64

The impact of Pocket Ultrasound Devices on physical examinations
Page 66

An ultra modern Swiss hospital focussed on orthopedics
Page 68

The growth of 3D printing in biomedicine: applications in radiology
Page 71

REGULARS

5-14 | IMAGING NEWS

32-36 | INDUSTRY NEWS

76 | RADPATH: A PLATFORM FOR INTEGRATING INFORMATION IN CANCER DIAGNOSIS

78 | AGFA HEALTHCARE GETS SERIOUS ABOUT INTEGRATED CARE

81 | FOUR-POINT ORDER-PRIORITY SCORE IN THE ED AND INPATIENT SETTING

84 | ENTERPRISE-WIDE IMAGING COULD RELIEVE THE CURRENT PRESSURE IN RADIOLOGY

86 | SHEARWAVE ELASTOGRAPHY AND BREAST IMAGING

91 | A FLOURISHING PRIVATE PRACTICE FOCUSED EXCLUSIVELY ON DIAGNOSTIC MAMMOGRAPHY

93 | NEW TOMOSYNTHESIS APPLICATIONS ENHANCE CLINICAL VERSATILITY

94 | TECHNOLOGY UPDATE

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COMING SOON IN THE NEXT ISSUE:
3D printing
Analysis of PACS usage
Researchers developing new hybrid PET/MRI system for improved breast cancer diagnosis

A new EU-funded project known as HYPMED aims to develop a ground-breaking imaging method for more accurate detection of breast cancer and a better, more personalized, understanding of its response to therapy.

Breast cancer is the most common type of female cancer and continues to be one of the main causes of cancer death in women. Despite the advances made in modern medicine and contemporary targeted therapies, the stage of breast cancer at the time of diagnosis is still the most important driver of patient survival. This means that there is an obvious and persisting need for an improved early diagnosis of this disease.

The project, Digital Hybrid Breast PET/MRI for Enhanced Diagnosis of Breast Cancer, or HYPMED for short, will develop a hybrid system of two medical imaging modalities (MRI and PET) for improved diagnosis of breast cancer and personalized therapy control. A European consortium made up of nine partners from leading universities, research organizations and industry has recently started the ambitious research initiative.

“The HYPMED project combines visionary clinical expertise with excellence in physical and engineering sciences and the developed technology will greatly help us to choose an appropriate treatment that is exactly right for a given cancer in a given woman”, states, Prof. Christiane Kuhl from University Hospital Aachen, Germany and Scientific Coordinator of the project.

The innovative concept also convinced the reviewers of the EU Horizon 2020 research program, who awarded the HYPMED project proposal the highest evaluation score possible.

The HYPMED project started on January 1st, 2016 and will involve over a 4-year period recognized organizations and industry partners from all over Europe: European Institute for Biomedical Imaging Research, AT (Project Coordinator); University Hospital Aachen, DE (Scientific Coordinator), Forschungszentrum Jülich, DE; Medical University of Vienna, AT; Technical University Delft, NL; University Hospital Münster, DE; NORAS MRI Products GmbH, DE; Futura Composites, NL; INTRASENSE, FR; Philips Electronics, NL.

The HYPMED project receives funding from the European Union’s Horizon 2020 research and innovation programme. www.eibir.org/news-2

Tau Imaging in Aging and Early Alzheimer Disease

A recent paper (Johnson KA et al Tau positron emission tomographic imaging in aging and early Alzheimer disease. Ann Neurol. 2016; 79(1):110) from a Boston-based group of researchers describes their investigation into the use of 18F T807 as a biomarker for tau pathology in Alzheimer disease (AD). 18F T807 is otherwise known as Fluorine-18 labelled 7-(6-fluoropyridin-3-yl)-5H-pyrido[4,3-b]indole and is a potent and selective agent for imaging paired helical filaments of tau (PHF-tau) and among the most promising PET radiopharmaceuticals for this target.

The researchers recruited 75 participants of the Harvard Aging Brain Study. Of the 75 patients (mean age, 73), 56 were cognitively normal, 13 had mild cognitive impairment (MCI), and 6 had dementia based on clinical evaluation that included the Mini-Mental State Examination, Clinical Dementia Rating scale, and Logical Memory delayed recall test. Tau deposition was identified using standardized uptake value ratio from 18F T807 positron emission tomography imaging, and amyloid deposition was identified using distribution volume ratio from 11C Pittsburgh Compound B (PiB) imaging.

The researchers found that corresponding to the Braak neuropathology staging scheme for AD, tau deposition was minimal or localized to the medial temporal lobe in the cognitively normal group, and greater tau deposition in the temporal and neocortical areas was seen in the participants with MCI and dementia. Compared with the cognitively normal group, the MCI/dementia group had greater tau examinations, be comparable to a regular digital mammogram.

The HYPMED approach is also likely to be transferable to other clinical applications, such as prostate cancer detection and hybrid cardiac imaging. “We believe that this will introduce a paradigm shift in the field of PET/MR hybrid imaging with many new applications in other diseases. With the success of the HYPMED project, we will open up a whole new chapter of medical hybrid imaging,” says Prof. Schulz, head of the Department of Physics of Molecular Imaging Systems at Aachen.

The project’s ambition is to develop a radiofrequency coil that can be connected to any regular clinical MR scanner and transform the device into a high-resolution PET/MRI hybrid system, which can be used to identify even the smallest breast cancer foci and better characterize the cancer as well as its response to therapy. Patients will also benefit as the radiation dose of the new technology will, in contrast to other PET-MRI examinations, be comparable to a regular digital mammogram.
Deposition in the entorhinal and parahippocampal regions, but not in the hippocampus. Tau deposition in the inferior temporal and fusiform regions was also lowest in cognitively normal participants and highest in those with dementia. Greater inferior temporal tau binding and mean cortical PiB binding was associated with greater impairment on all clinical evaluation measures in those with MCI/dementia. Greater inferior temporal $^{18}$F T807 binding also was associated with higher mean cortical PiB binding in the entire sample.

The researchers concluded that $^{18}$F T807 can be a useful biomarker for tau pathology and clinical impairment in AD.

Accumulation of amyloid plaques has been associated with the asymptomatic phase of AD, preceding neurofibrillary tangle development from tauopathy that occurs during the symptomatic phases of the disease. The authors concluded that $^{18}$F T807 can be considered as an additional tau biomarker in the AD process, although the unexpected lack of hippocampal tau deposition in MCI/dementia patients and its usefulness in clinical practice warrants further investigation.

http://tinyurl.com/18F-T807-PET-paper

Study shows ASIR improves radiologists’ diagnostic performance for the diagnosis of hypervascular liver

A group of researchers from Duke University in Durham, NC, USA set out to prospectively evaluate whether clinical experience with an adaptive statistical iterative reconstruction algorithm (ASiR) had an effect on radiologists’ diagnostic performance and confidence for the diagnosis of hypervascular liver tumors, as well as on their subjective perception of image quality (Marin D et al. Effect of radiologists’ experience with an adaptive statistical iterative reconstruction algorithm on detection of hypervascular liver lesions and perception of image quality. Abdom Imaging. 2015;40: 2850). In the study forty patients, having 65 hypervascular liver tumors, underwent contrast-enhanced MDCT during the hepatic arterial phase. Image datasets were reconstructed with filtered backprojection (FBP) algorithm and ASiR (20%, 40%, 60%, and 80% blending). During two reading sessions, performed before and after a three-year period of clinical experience with ASiR, three readers assessed datasets for lesion detection, likelihood of malignancy, and image quality. The results showed that for all reconstruction algorithms, there was no significant change in readers’ diagnostic accuracy and sensitivity for the detection of liver lesions, between the two reading sessions. However, a 60% ASiR dataset yielded a significant improvement in specificity, lesion conspicuity, and confidence for lesion likelihood of malignancy during the second reading session ($P<0.0001$). The 60% ASiR dataset resulted in a significant improvement in readers’ perception of image quality during the second reading session ($P<0.0001$).

The researchers concluded that the use of an ASiR algorithm improves radiologists’ diagnostic performance for the diagnosis of hypervascular liver tumors, as well as their perception of image quality.

http://tinyurl.com/Marin-et-al-paper

What patients would like to know about radiation dose

A recently published study (Ukkola L et al. Information about radiation dose and risks in connection with radiological examinations: what patients would like to know. Eur Radiol. 2016; 26: 4363) from a Finnish group describes their investigation of the wishes of patients regarding the content and sources of information concerning radiological procedures.

The group prepared a questionnaire providing quantitative and qualitative data, and containing general information on dose and risks of radiation, and the source of information. Two tables demonstrating different options to indicate the dose or risks were also provided. Patients were asked to choose which type of information they preferred. Altogether, 147 patients were interviewed after they had undergone radiological examinations.

It was found that 95 % of the patients wanted dose and risk information. Symbols and verbal scale were preferred as the means of revealing the dose, whereas verbal and numerical scale were preferred to indicate the risks of fatal cancer. Wishes were also expressed concerning information on the course, options and purpose of the examination.

Apart from general information, patients wanted dose and
risk information in connection with radiological examinations. The majority preferred symbols to indicate dose and verbal scales to indicate risks, and the preferred source of information was the prescriber or an informative letter. http://tinyurl.com/Ukkola-et-al-paper.

**Major breakthrough in the Improvement of Pre-Operative Diagnosis of Ovarian Cancer using Ultrasound**

In a landmark study, investigators from Europe propose a new and simple method to assess the risk of malignancy of women with an adnexal mass (D Timmerman et al, Predicting the risk of malignancy in adnexal masses based on the Simple Rules from the International Ovarian Tumor Analysis group Am J Obstet Gynecol. 2016;9378(16):00009). The method identified between 89-99% of patients with ovarian cancer using the results of ultrasound examination, which can be obtained in referral and non-referral centers. The work is based on the “Simple Rules”, criteria developed by the International Ovarian Tumor Analysis (IOTA) group to improve accurate diagnosis of ovarian cancer before surgery. Published in the American Journal of Obstetrics and Gynecology, this new approach has the potential to level and raise the playing field and put expert interpretation and improved diagnostic capability within reach of all practitioners.

Ovarian cancer is a common and potentially lethal disease, but early detection and treatment improve survival. However, adnexal masses, ovarian masses or cysts that persist and become enlarged, often pose a diagnostic dilemma because preoperative tests to determine if they are benign or malignant are often inconclusive. The IOTA group developed a set of “Simple Rules” based on ultrasound images of the adnexal masses, which allows them to be classified as either benign or malignant.

Although the Simple Rules have been well-received by clinicians, an important question from patients and physicians has been whether it is possible to calculate the individual risk of malignancy for a particular patient. In the just published study the IOTA group led by Prof.Dirk Timmerman, sought to develop and validate a model to predict the risk of malignancy in adnexal masses using the ultrasound features derived from the Simple Rules. The study represents the culmination of multiple consecutive multicenter studies involving 22 centers in 10 countries over 13 years (1999 to 2012) and approximately 5,000 patients with adnexal masses.

“The Simple Rules are intuitively attractive because of their ease of use. However, when used as originally suggested, they
High-deductible insurance in U.S. linked to lower use of medical imaging studies

Diagnostic imaging utilization has grown rapidly over the past two decades. It remains unclear whether patient cost-sharing is an effective policy method to reduce imaging utilization and spending. In the United States, more and more Americans are enrolling in high-deductible insurance plans, which have relatively low premiums but higher out-of-pocket costs. Such plans increase the patient’s share of the cost of healthcare services, which proponents of high-deductible plans argue helps reduce overuse. A recent study set out to examine whether patients enrolled in high-deductible health insurance plans have lower rates of use and lower costs for imaging tests (Zheng S et al. Reductions in Diagnostic Imaging With High Deductible Health Plans. Med Care. 2016; 54:110).

Using an insurance database including more than 21 million adults, the researchers compared use rates and costs of imaging studies — x-rays, CT or MRI scans, and others — for patients with and without high-deductible insurance plans. The results show that high-deductible plans are associated with lower use of imaging studies. This is an important finding, given the high cost of imaging tests in the US healthcare system. From 2000 to 2014, Medicare spending for imaging almost tripled: from $3.6 billion to $10.0 billion. Patients in high-deductible plans were less likely to undergo any diagnostic imaging study. However, once an enrollee had at least one imaging test, being in a high-deductible plan had little effect on the total use of and payments for imaging studies.

“Increased patient cost-sharing may contribute to reductions in diagnostic imaging utilization and spending,” said lead author Sarah Zheng, MA, of Boston University Questrom School of Business. But she cites potential concerns over whether high-deductible plans may discourage use of medically recommended, “high-value” imaging studies as well as less critical, “low-value” tests such as lumbar spine MRIs for lower back pain.

Previous research has shown that outside of radiology high-deductible insurance plans lead to reduced use of a wide range of healthcare services: hospital care, office and emergency department visits, and others. The new study is the first to directly address the effects on use of diagnostic imaging studies nationwide. “As diagnostic imaging can have important downstream care and cost implications, having the right level of high-value utilization is an important policy priority,” the researchers write.

However, the study was unable to determine whether the reduced imaging use associated with high-deductible insurance was high- or low-value—an important consideration for patient outcomes. Along with previous studies, the results raise concerns that “high-deductible health plans may be a blunt instrument reducing all diagnostic imaging, rather than helping physicians and patients choose high-value imaging,” the researchers write. "Increased patient cost-sharing may contribute to reductions in diagnostic imaging utilization and spending,” said lead author Sarah Zheng, MA, of Boston University Questrom School of Business. But she cites potential concerns over whether high-deductible plans may discourage use of medically recommended, “high-value” imaging studies as well as less critical, “low-value” tests such as lumbar spine MRIs for lower back pain.

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Twitter offers valuable insights into the experience of MRI patients

Tweets can give medical professionals a window into the minds of patients, according to a new study published in the Journal of Medical Imaging and Radiation Sciences. MRI can be a stressful experience for many people, but clinicians have few ways to track the thoughts and feelings of their patients regarding this procedure. While the social networking site...
Building on its 100+ years of experience, Agfa HealthCare develops innovations that offer the ease of use customers need to maximize the potential of their solutions, with designs that keep the user and customer in mind. With its strategy of one platform for IT and one platform for imaging, the company is doing exactly that: simplifying even while enhancing performance.

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Small Polyps at Endoluminal CT Colonography Are Often Seen But Ignored by Radiologists

A group of UK clinicians carried out a study to describe the characteristics of polyps viewed, but then dismissed incorrectly by radiologists at endoluminal CT colonography (CTC). The group also analyzed eye movements during these errors, and the features provoking false-positive diagnoses (Plumb AA, et al. Small Polyps at Endoluminal CT Colonography Are Often Seen But Ignored by Radiologists. AJR Am J Roentgenol. 2015; 205(4): W424-31).

In the study, 42 radiologists viewed 30 endoluminal CTC videos, each depicting a polyp, while their eye movements were tracked. Half of the videos had computer-assisted detection (CAD), and half did not. Classification errors were defined when proven polyps were seen but dismissed. Eye movements during these errors and during correct polyp identifications were compared with multilevel modeling. Polyps were divided subsequently into “difficult to classify” and “easy to classify” using a classification error threshold of more than 15%. Polyp diameter, height, and subjective conspicuity and the proportion of time viewed were compared between groups.

It was found that eye tracking revealed that 97% of false-negative polyp diagnoses were nonetheless preceded by the reader observing the polyp. The difficult polyps were significantly smaller than the easy polyps (mean diameter, 5.4 vs 8.2 mm, respectively; p = 0.014) and were subjectively less conspicuous (median score, 4 vs 2; p = 0.0032). Readers spent proportionally less time viewing difficult polyps than viewing easy polyps (29.0% of the time they were on-screen vs 42.6%, respectively; p = 0.01) regardless of the presence of CAD.

The researchers conclude that even small and subjectively inconspicuous polyps attract reader gaze, but they are nonetheless ignored. These errors are made rapidly even with CAD. Efforts to improve reader performance at CTC should focus on decision making rather than detection alone.

http://tinyurl.com/Plumb-et-al-paper
A team of Oxford University researchers has developed a technique that could improve heart scans for patients, giving more information about the heart than traditional scans and without any injection of contrast media, making them safer and faster.

The group of medical, physics and engineering researchers are based at the Oxford Centre for Clinical Magnetic Resonance Research (OCMR). They are using a property of hydrogen atoms to create a pixel-by-pixel T1-map of the heart, which allows examination of healthy and diseased heart tissue in greater detail than before.

Currently, stress scans of the heart using magnetic resonance imaging (MRI) require patients to be injected with two substances. Adenosine is administered to the patient and causes effects similar to exercise during the scan. Gadolinium—a rare earth heavy metal—is injected as a contrast agent to highlight areas of the heart suffering from decreased blood flow under exercise conditions.

Dr Alexander Liu, who leads the research explained: 'We wanted to see if using T1 mapping can give clearer, more clinically-useful results compared to traditional MRI scans that require injections of contrast agents. On traditional MRI scans, doctors are judging relative shades of light and dark on a scan, and even the most experienced specialists can disagree on what the image is showing them. T1 maps provide an objective number, which can be coded in colours, and may be less subjective. Additionally, patients with severe kidney failure—who are usually at higher risk for heart disease—cannot clear gadolinium and are often unable to benefit from a full MRI scan of the heart. T1-maps can potentially solve this problem in the future.'

'T1 is the time constant that describes how quickly atoms return to normal thermodynamic state after being affected by radio waves and strong magnetic fields. In the case of T1 mapping, long T1 times indicate the presence of more fluid, something found in a number of heart conditions, including areas of the heart suffering from lack of blood supply due to blocked arteries. A T1-map just helps to visualize T1 values across the heart and find the precise location of the problem. It takes around three minutes to map the whole heart, and the values it measures are turned into a colour map, giving doctors an image which is potentially quicker to understand with less subjective interpretation.'

Dr Stefan Piechnik developed the specific T1 mapping technique at Oxford, named ShMOLLI. He said: 'T1 mapping allows us to look in finer detail at the heart in a non-invasive way, which has not been possible before. We can now get results without Gadolinium, meaning we have a technique that is safer and quicker and can be used with more people. The results are also less dependent on interpreting the images—medics have something based on hard numbers.'

Dr Liu added: 'Further studies will concentrate on how we can use T1 mapping not only to improve our research but eventually develop this into a tested, clinically proven technique for use with patients worldwide.'

Dr Vanessa Ferreira, Deputy Clinical Director of the OCMR, said: 'The potential of this research is huge—not only for heart scans. Each type of tissue across the body has a range of normal T1 values, so any values outside that range may signify disease. The pixel-by-pixel level of detail from these scans could help identify unhealthy tissue wherever it appears. At Oxford we are now applying the technique to scan other organs. The UK Biobank also aims to scan 100,000 individuals from the UK population using the ShMOLLI T1-mapping technique, which will provide a lot of information on T1 values in health and in certain medical conditions. All these studies aim to translate the technique into one suitable for routine clinical use, which the investigators estimate to be likely within the next five years.'

www.ocmr.ox.ac.uk

New recommendations offer guidance on when to use imaging for chest pain patients in the ED?

The American College of Cardiology and American College of Radiology have issued new recommendations that define when diagnostic imaging is appropriate—or not—for patients presenting to the emergency department with chest pain (Rybicki FJ et al. 2015 Appropriate Utilization of Cardiovascular Imaging in Emergency Department Patients With Chest Pain: A Joint Document of the American College of Radiology Appropriateness Criteria Committee and the American College of Cardiology Appropriate Use Criteria Task Force. J Am Coll Cardiol. 2016;23;67; 85)

The document covers 20 clinical scenarios encompassing four clinical entry points: suspected non-ST-segment elevation acute coronary syndromes, pulmonary embolism, acute aortic syndromes, and cases in which leading diagnoses are not possible. With the assumption that all chest pain patients will initially undergo a history, physical exam, electrocardiography, and,
potentially, biomarker testing, the groups’ conclusions include:

- When the initial workup or chest radiography yields a likely noncardiac diagnosis (e.g., pneumothorax), cardiac imaging is rarely appropriate.

- When ECG or biomarker testing is “unequivocally” positive for ischemia, catheter-based coronary angiography is appropriate; other rest imaging procedures are rarely appropriate.

- If the clinician suspects non-ST-elevation MI but the initial ECG is normal or nonischemic and the initial troponin finding is normal, then coronary CT angiography is appropriate, rest SPECT may be appropriate, and rest echocardiography, rest coronary magnetic resonance, and catheter angiography are rarely appropriate.

Dr. Harlan Krumholz of NEJM Journal Watch Cardiology said “We all know that imaging is overused for chest pain evaluations — in part because of an environment that punishes acts of omission over acts of commission and a litigious culture that pushes doctors to be overly cautious (neglecting the harms of overtesting). And then there is the financial incentive. This document will provide support for decision-making ... the key thing is to listen to the patient, carefully consider all evidence, and understand and communicate the trade-offs of the diagnostic choices.”

http://tinyurl.com/Rybicki-et-al

Comparative trial of methods of screening for colorectal cancer

Colorectal cancer is the third most diagnosed cancer in the world, and population screening has been suggested or recommended for early disease detection. However, the most optimal method to screen for the disease remains unknown. In order to compare different screening methods for colorectal cancer, Lapo Sali, and colleagues from Florence, Italy carried out a single-center randomized controlled screening trial, with four parallel groups: biennial fecal immunochemical test (FIT) for three rounds, reduced (r-CTC,) and full cathartic prep- aration CT colonography (f-CTC,) and optical colonoscopy (OC) in patients aged 54-65 years. (Sali L et al. Reduced and Full-Preparation CT Colonography, Fecal Immunochemical Test, and Colonoscopy for Population Screening of Colorectal Cancer: A Randomized Trial. J Natl Cancer Inst. 2015; 108(2) pii: djv319.

A total of 16,087 subjects were involved. The researchers found that participation was different across the four screening methods (50.4% for first-round FIT, 28.1% for r-CTC, 25.2%, for f-CTC, and 14.8% for OC), but detection rates (DRs) of advanced neoplasia were different only between CTC and FIT groups (1.7% for first-round FIT, 5.5% for r-CTC, 4.9% for f-CTC, and 7.2% for OC). They conclude that “The combination of lower attendance and higher DR of screening CTC as compared with FIT are key factors for the optimization of its role in population screening of CRC.” In an accompanying editorial, Dr. E. J. Kuipers and Dr M. C. W. Spaander of Erasmus University Medical Center, Rotterdam write that the differences in the types of screening for colorectal cancer are such that there is no test or program design that makes one type of screening better than the other. However they feel that follow-up of these types of screenings is essential, and therefore find that the study is useful to identify and combat the disease. The authors conclude that limiting the bowel preparation increases participation in CTC. This is an important new finding that is in line with previous observations that ease is an important determinant of screening uptake

http://tinyurl.com/Sali-et-al-paper

Comparative evaluation of PET/MRI, PET/CT, MRI, and CT in whole-body staging of recurrent breast cancer

A group of German researchers compared the diagnostic performance of 18F-fluorodesoxyglucose positron emission tomography/magnetic resonance imaging (18F-FDG PET/MRI) with 18F-FDG PET/computed tomography (18F-FDG PET/CT), MRI, and CT in whole-body staging of recurrent breast cancer. (Sawicki LM, et al. Evaluation of (18)F-FDG PET/MRI, (18) F-FDG PET/CT, MRI, and CT in whole-body staging of recurrent breast cancer. Eur J Radiol. 2016;85:459)

The study involved 21 patients with suspected breast cancer recurrence who underwent a clinically indicated 18F-FDG PET/CT and subsequently a 18 F-FDG PET/MRI examination in a single injection protocol. Images from each 18 F-FDG PET/CT, 18F-FDG PET/CT, as well as the CT component of PET/CT (CT Pet/CT) and MR images of PET/MRI (MRIPT/MRI) were separately evaluated by two radiologists regarding lesion count, lesion localization, and lesion categorization (benign/malignant). The reference standard was histopathological results as well as prior and follow-up imaging.

According to the reference standard, 17 patients had breast cancer recurrence. PET/MRI, PET/CT, and the MRI component
of PET/MRI correctly identified each of the 17 patients, whereas the CT component of PET/CT correctly identified 15 of the 17 patients. A total of 134 lesions were described PET/MRI detected all 134 lesions, while PET/CT, MRIPET/MRI, and CTPET/CT detected 97.0%, 96.2%, and 74.6%, respectively. PET/MRI yielded the highest proportion of correctly categorized lesions (98.5%) compared with PET/CT (94.8%), MRIPET/MRI (88.1%), and CTPET/CT (57.5%).

The researchers concluded that PET/MRI offered the highest diagnostic performance compared with PET/CT, MRI and CT and that PET/MRI should be regarded as a valuable alternative in whole-body staging of recurrent breast cancer.

http://tinyurl.com/Sawicki-et-al-paper

Brain scans suggest Learning a Second Language May Depend on the Strength of Brain's Connections

Learning a second language is easier for some adults than others, and innate differences in how the various parts of the brain “talk” to one another may help explain why, according to a recent study (Chai XJ, et al. Intrinsic Functional Connectivity in the Adult Brain and Success in Second-Language Learning. J Neurosci. 2016; 36(3): 755).

Participants with stronger connections between the left AI/FO and an important region of the brain's language network called the left superior temporal gyrus showed greater improvement in the speaking test. Participants with greater connectivity between the VWFA and a different area of the left superior temporal gyrus language area in the left temporal lobe showed greater improvement in reading speed by the end of the 12-week course.

“The most interesting part of this finding is that the connectivity between the different areas was observed before learning,” said Arturo Hernandez, a neuroscientist at the University of Houston who studies second-language learning and was not involved in the study. “This shows that some individuals may have a particular neuronal activity pattern that may lend itself to better learning of a second language.”

However, that doesn't mean success at a second language is entirely predetermined by the brain's wiring. “The brain is very plastic, meaning that it can be shaped by learning and experience,” Chai pointed out.

http://tinyurl.com/Chai-et-al-paper

Alzheimer's Plaques Linked to Brain Injury in Middle-Aged People

A team of researchers from Imperial College London UK, performed PET and MRI brain scans on nine people with a single moderate to severe traumatic brain injury (TBI), [Scott G et al Amyloid pathology and axonal injury after brain trauma. Neurology. 2016 Feb 3; pii: 10.1212]. Participants had an average age of 44 and had suffered their brain injury between 11 months and up to 17 years before the study began. The brain scans of people with TBI were compared to brains...
of nine healthy participants and 10 people with Alzheimer’s disease.

The researchers found that head trauma can sometimes cause the buildup of plaques associated with Alzheimer’s.

“Whilst other studies have shown this, and some very directly through autopsy, ours is the first to look at TBI patients this late on after their injury, and to relate the findings to white matter damage,” Scott said.

The researchers found patients with more damage to the brain’s white matter had an increase in plaques. Both people with Alzheimer’s disease and those with TBI had plaques in the posterior cingulate cortex, an area affected in the beginnings of Alzheimer’s. Plaques were found in the cerebellum only in participants with TBI. Healthy participants had relatively little or no plaque buildup compared to the other two groups.

“It suggests that plaques are triggered by a different mechanism after a traumatic brain injury,” said study author Professor D. Sharp also of Imperial College London, “The damage to the brain's white matter at the time of the injury may act as a trigger for plaque production. If larger studies confirm the findings, then it may help neurologists to target treatments to fend off the disease earlier, Sharp added.

“The areas of the brain affected by plaques overlapped those areas affected in Alzheimer’s disease, but other areas were involved,” Sharp said. “People after a head injury are more likely to develop dementia, but it isn’t clear why. Our findings suggest TBI leads to the development of the plaques which are a well-known feature of Alzheimer’s disease.”

http://tinyurl.com/Scott-et-al-paper

Guided ultrasound plus nanoparticle chemotherapy shows promise in curing cancers

Thermal ablation with magnetic resonance-guided focused ultrasound surgery (MRgFUS) is a noninvasive technique for treating fibroids and cancer. New research from UC Davis shows that combining the technique with chemotherapy can allow complete destruction of tumors in mice. (Wong AW et al. Ultrasound ablation enhances drug accumulation and survival in mammary carcinoma models. J Clin Invest. 2016;126:99)

MRgFUS combines an ultrasound beam that heats and destroys tissue with magnetic resonance imaging to guide the beam and monitor the effects of treatment. The effectiveness of the treatment can be limited by the need to spare normal tissue or critical structures on the tumor margins, as well as the need to eliminate micrometastases.

The group of researchers describe a strategy that can destroy an entire tumor without thermal destruction of the tumor margin and they demonstrated a dramatic increase in the concentration of anti-cancer chemotherapeutic drugs within several types of MRgFUS thermal ablation-treated tumors.

“MRgFUS is already FDA approved for the treatment of uterine fibroids and palliation of bone metastases. We hope to expand the indication for MRgFUS by supplementing it with chemotherapy,” said first author Andrew Wong.

The group’s previous research has shown that ultrasound-induced mild hyperthermia can enhance the accumulation of tiny nanoparticles carrying anti-cancer drugs, but the accumulation is dependent on the type of tumor. The group hypothesized that combining thermal ablation and chemotherapy could improve efficacy across multiple types of tumors.

The team used a variety of techniques including combined positron emission tomography/computed tomography (PET-CT), magnetic resonance imaging, autoradiography, and fluorescence imaging to track nanoparticles loaded with the chemotherapy drug doxorubicin in a mouse model of breast cancer.

They found that as the ultrasound damaged the tumor and induced a local immune response, nanoparticles accumulated in the tumor and the local drug concentration increased 50-fold. The high drug concentrations continued over several weeks, increasing total exposure of the tumor to the drug.

The research team found that the enhanced drug accumulation induced by MRgFUS resulted in improved survival and a consistent cure in their preclinical murine model of breast cancer, even when part of the tumor was left intact.

They also demonstrated that an effective cure could be achieved with a carefully designed protocol involving heat-activated nanoparticles, which, when gently heated by ultrasound, release their chemotherapeutic payload in the vasculature surrounding the tumor.

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Debating the value of mammography screening in average risk women following the publication of 25-year follow-up in the Canadian National Breast Screening Study

INTRODUCTION
On the heels of a change in breast cancer screening recommendations for average risk women by the Canadian Task Force on Preventive Health Care in 2011, reducing the recommended screening interval to once every two years from ages 50-74 [1], the debate regarding the benefits of screening mammography in Canada reigned. The Canadian National Breast Screening Study (CNBSS) was published in 2014 by Miller et al. [2] which, rather than clarifying the issue, prompted further debate. Physicians seem more divided than ever regarding the interpretation of this study and whether it supports or refutes the value of screening mammography for average risk women [3].

SUMMARY OF THE CANADIAN NATIONAL BREAST SCREENING STUDY
The CNBSS was a Canadian multi-centered randomized clinical trial conducted in 15 screening centres in six provinces across Canada from 1980-1988. A total of 89,835 women participated, into two separate studies that were later merged for this 25-year publication. The first study involved almost 50,000 women aged 40-49, who underwent a physical examination by a study nurse and were then randomized to ‘usual care’ (meaning no formalized screening) or ‘mammography’ (meaning annual mammogram plus physical examination for five years). The second study involved almost 40,000 women aged 50-59, who likewise underwent a physical examination by a study nurse and were then randomized to ‘physical examination’ (annual physical examination only for five years) or ‘mammography’ (annual mammography and physical examination for five years). Following the five years of screening, the women were returned to usual care with their physicians and were not seen again.

One of eight randomized controlled trials evaluating mammography screening, the CNBSS is probably one of those with the most rigorous design, with individual level randomization and comprehensive follow-up. Whether any breast screening was performed in any of the women following the five year period was not known.

During the five-year screening period, 1190 breast cancers were detected in both age cohorts (666 in the mammography arm and 524 in the control arm). Of note, an additional 5193 breast cancers were diagnosed in the 20 subsequent years without screening (2584 in the mammography arm and 2609 in the control arm). After 25 years, there was no significant difference in overall cumulative breast cancer-specific mortality between the screened and control arms. There was, however, a significant reduction in breast cancer-specific mortality associated with mammography screening in the first year (prevalent cancers) but not in the subsequent years 2-5 (incident cancers). When comparing survival rates, there was a significant difference in the 25-year survival for women with breast cancer detected in the mammography arm compared with the control arm (70.6% versus 62.8%). This difference is more pronounced when comparing the non-palpable cancers diagnosed in the mammography arm (79.6% versus 62.8%) with a significant improvement in survival in non-palpable versus palpable cancers, which many would feel represents the intended benefit of screening prior to palpability.

A number of concerns regarding the design of the study and potential limitations of its findings were vigorously debated among breast imagers, surgeons and policy makers. Although the ‘open book sequential randomization’ was done locally by each site coordinator, there were
concerns raised that the process was not independent of
the physical examination, since in the first year there were
almost 50% more cancers diagnosed in the mammography
arm versus the control arm, which cannot be attributed to
chance alone. There were 23% more cancers diagnosed in the
mammography arm in year 2, and then cancer diagnosis rates
stabilized at 15% more cancers per year in the mammography
arm versus the control arm. This difference in diagnosis may
in part represent what some term ‘over-diagnosis’ and others
call ‘over-detection’ of clinically irrelevant cancers [4].

Although tumors diagnosed in the mammography arm
were smaller than in the control cohort (1.9 cm versus 2.1
cm, with no significant difference in lymph node positivity
rates between the two arms), the quality of mammograms
have significantly improved since the 1980s, particularly with
the advent of digital mammography. It is accepted that tumor
size is correlated with clinical outcome, not only in survival
but also in reduced treatment (less need for mastectomy and
lower rates of chemotherapy). It has been argued that digital
mammography will reduce the size of image-detected can-
cers even further, perhaps providing additional benefits not
captured by this study [4]. Given that sixty-eight percent of
all cancers diagnosed were palpable, the benefits of screening
could therefore only have been truly evaluated in the remain-
ing one third of cancers, and that the technical limitations at
the time of the study prohibited an effective evaluation of the
imaging modality currently in use [5].

CONCLUSIONS
The balance between improving early detection and diagno-
sis of clinically meaningful breast cancers and risking over-
detection of clinically irrelevant cancers continues to elude
us, and neither one should fully trump the other. Ideally,
improved imaging, genomic or phenotypic signatures need
to be developed to differentiate high from low risk cancers so
that patients can be treated accordingly. It is likely that the
treatment of breast cancer in the future will mimic that of
prostate cancer with the adoption of watchful waiting for low
risk cancers. In the interim, a discussion with patients about
the risks and benefits of screening mammography continues
to be important and should be individualized.

SUMMARY RECOMMENDATIONS FOR BREAST SCREENING
Authors of the CNBSS argued that a 5-year screening
intervention failed to significantly impact on breast cancer-
specific mortality at 25 years and should therefore be aban-
donned in average risk women. Perhaps given the limita-
tions outlined above, the Canadian Preventative Task Force
guidelines have not changed. A polarization has developed
in the medical literature however, with surgical oncologists
who treat these patients endorsing annual screening begin-
ing at the age of 40 [6]. This is in recognition of what is
felt to be a smaller but persistent improvement in breast
cancer-specific survival among screened versus unscreened
women aged 40-49, even if not cost-effective and associ-
ated with a higher number needed to treat. In contrast,
policy advocates have quoted the CNBSS study as evidence
that such universal population-based screening is associ-
ated with significant harms such as false positive findings,
over-diagnosis, unnecessary treatment and psychological
distress and should therefore be abandoned [7].

On the whole, our debate [3] determined that the evidence
from the CNBSS study did not impact the current Canadian
guidelines (offering screening mammography to average risk
women starting at the age of 50 and every 2 years until age 74),
which should be continued in the absence of better stratifica-
tion for low and high risk among these early detected cancers.

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Towards a Rebalancing of Mammography’s Harms and Benefits

How Harmful is Screening Mammography in 2016?

The recent release of the 2015 breast cancer screening guidelines of the United States Preventive Service Task Force (USPSTF) [1] and subsequent articles [2-4] and press coverage have generally underlined the harmful effects of screening mammography while downplaying its positive effects. The major harms include ‘overdiagnosis’ of cancer and ‘overtreatment’ of non-threatening disease, false-positive diagnoses and attendant unneeded medical interventions. These are all serious and credible criticisms of decades of mammography promotion primarily stressing the positive benefits of screening.

But screening mammography today is quite different from the mammography of 30 years ago that formed the basis of the randomized trials. These outdated trials provide the evidence upon which the USPSTF and many commentators rest their critiques. It is not so much that the criticisms are entirely wrong as they are embedded in a past that is no longer very relevant to contemporary advances and understanding. A systemic review of harms was undertaken recently to support the USPSTF 2009 recommendation but concluded: “Although overdiagnosis, anxiety, pain and radiation exposure may cause harm, their effects on individual women are difficult to estimate and vary widely.” [5].

Overdiagnosis and overtreatment

Overdiagnosis and overtreatment have been consistent criticisms of screening mammograms from the beginning. They have been applied to ductal carcinoma in situ (DCIS) and invasive carcinomas without distinguishing the potential differences in clinical outcomes. A rising tide of opinion now demands reevaluation of the impact of DCIS. Accumulating evidence from a sentinel registry study [6] supports the current view that much DCIS does not often lead to invasive cancer. Oncologists are coming to accept the idea that DCIS should not be called a carcinoma at all [7], and that certain radiologic presentations of DCIS should be noted and ignored. [8] All of this sets the stage for a retrenchment from the hunt for DCIS, and thus a significant reduction in the overdiagnosis and overtreatment of a cancer that mostly isn’t. Yet, a new report [9] using only ecologic data, claims that detection and treatment of DCIS is useful in preventing future invasive cancers. Final agreement about the role of DCIS in invasive disease remains elusive.

The claim that invasive cancer is overdiagnosed is dangerous. Fewer than 10% of invasive breast cancers are pathologically classified as “less aggressive” or with low metastatic potential. In the near future, with molecular profiling and meticulous pathological staging, it may well be possible to reliably identify “unaggressive” invasive cancers. As we become better and better in categorizing threatening and less threatening invasive cancers, treatments will be modified accordingly and hopefully overtreatment will become a thing of the past. But much confirmatory work needs to be done. In the meanwhile, it would be a tragic error to restrict mammography from diagnosing invasive cancers.

False-Positive Diagnosis and Unnecessary Medical Interventions

A persistent criticism of having repeated mammograms is the greatly increased risk of false diagnosis and attendant unnecessary biopsies. [10]. The ensuing harms include unnecessary costs, physical pain and mental suffering. These criticisms stem from the reliance on older data based on older technology and older inadequacies of technician and radiologist training. Both current false positive

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Among the harms are psychological and long-lasting. The criticism of unnecessary pain suffering and anxiety is really out of date. Today, most biopsies are accomplished with the skinny needle and are almost painless. Significant anxiety and long-lasting psychological harms are rare. Relying on older data and emphasizing harms that are not associated with current radiologic and surgical practice paints quite a different picture than that painted by those whose expertise is in clinical practice [5].

The Harms of Not Screening

Role of Tumor Size and Lymph Node Status

The raison d’être of screening mammography has been to find breast cancers that are small, or “early” and have not spread outside the breast or into lymph or venous channels. There is also the related belief that finding such disease increases the chances that surgery, radiation and/or chemo-, immuno- or hormonal therapy will cure women of the disease or at least increases long-term breast cancer survival. Indeed, recent adjuvant trials have reported that cancers less than 1 cm can be associated with curative flat-line, long-term survival curves. Experimental studies have shown that as cancers divide and grow in size, more aggressive genes are expressed, supporting metastatic dissemination. Clinical studies have consistently linked increasing breast cancer size with the risk of having positive lymph nodes and with the risk of metastatic disease and death [13,14]. Contemporary risk prediction tools use various combinations of tumor size, lymph node status as well as tumor grade, estrogen receptor status, mammographic density and genomic signatures. Research continues to evaluate what the best tools to predict breast cancer aggressiveness and the propensity to metastasize may be. Meanwhile smallness does matter.

The Harms of Missing Small, Lymph Node Negative Cancers

In addition to harm of missing a small curable cancer, size matters for therapy. Local control is usually better when the primary disease is smaller. Smaller cancers can be treated with less surgery, less radiation therapy and often with less medical therapy. For the patient, more therapy means more side effects, more time in treatment. Costs are less for lumpectomies than for full mastectomies and reconstruction. Complex medical treatments take longer and are more expensive. Side effects can be permanent as well as temporary.

Less obvious harms are the increased disruptions of family life: more therapy-related symptoms, inability to continue working during treatment, costs of transportation to treatments, increased worries about the effects of treatments on cancer outcome and/or loss of medical insurance. Advanced stage cancers (any with lymph node involvement) are usually understood by patients as carrying a poorer prognosis that in turn arouses considerably more anxiety. The situation as understood and faced by women whose cancers have progressed beyond 1 cm or have involved nodes is much more stressful than that of a woman facing a diagnosis of a node-free 8-mm cancer. Waiting to diagnosis invasive cancers until they are readily found by clinical examination (2 cm or more) comprises therapy and raising the risk of incurable metastatic disease. That difference is real and the role of mammography is often the key difference.

It is argued that the absolute benefits of mammography have been downgraded by referring to the increasing effectiveness of cancer therapies in reducing mortality [15,16]. But that does not acknowledge the increased treatments that may be necessary to achieve a comparable long-term survival. Ask any woman who has undergone total mastectomy, reconstruction, radiation therapy and 12 cycles of a 4-drug regimen for a breast cancer that was 2 cm and involved 3 lymph nodes when discovered. Think of mammography as a way to “prevent” such overtreatment.

Caveats

It would be a mistake for one to think that mammography should become so perfect that only aggressive life threatening cancers would be diagnosed. All screening tests miss disease and misdiagnose nondisease. The balance point is not preordained but subject to value judgments of the individual and society. Fortunately, the practice of mammography continues to improve. Studies that were done over a generation ago should not be reified as the only truth about mammography. It may be time for epidemiologists and statisticians to consider other ways to judge the efficacy of a test that cannot be subjected to a randomized trial. We need to acknowledge that the science and practice of mammography have moved on and that harms that were quite real 10 or 15 years ago are no longer very germane [17].

Another mistake would be to equate all small breast cancers with good and larger with bad. There are some very aggressive small cancers, especially occurring in younger
women that are unresponsive to vigorous therapies, and present with widespread metastases [14]. As with any categorization, there may be outliers, and these small nasty breast cancers definitely are outliers. These small aggressive cancers may express molecular structures, for example HER2, that respond well to immunotherapy. Chen [18] in reviewing recent HER2 studies evaluating the effect of medical therapies on small breast cancers [19, 20] points out that survival was better predicted by tumor biology rather then size (whether the cancer was less or greater than 1 cm.) or whether the lymph nodes were positive or negative. She argues that the possibility of cure “is best defined by tumor biologic characteristics rather than tumor size and nodal status.”

Rethinking the Harms and Benefits Balance

Limiting acceptable scientific evidence on a group of 30-year-old randomized studies is hard to justify. Surely the experts can build models that use current day data to update the basis for their recommendations regarding harms and benefits. Current harms are less than the old data show and our ability to find smaller node negative cancers with better prognosis has improved. What would a scale show if we added the harms of not screening?

Can an updated, more complete balance sheet between harms and benefits be developed? Can the experts credibly calculate the enormous harm of missing a curable cancer: the short-term effects of therapy (nausea, loss of hair, tiredness, diarrhea, numbness and tingling of fingers and toes, multiple and lengthy clinic visits, anxiety, inability to work full time or at all) and the long-term not infrequent persistent effects of ‘chemobrain’, peripheral neuropathy, cardiac dysfunction, fear and anxiety about cancer recurring as well as the enormous costs [21] of medical care for immediate, chronic or metastatic disease? How can the experts weigh all that against the small discomfort of an unnecessary needle biopsy or a week of worry in falsely diagnosed women or the ‘cost’ or harm of many normal mammograms?

What the Future Might Hold

The uncertainly about DCIS may be resolved if both Narod’s [6] and Duffy’s [9] views result in an understanding that some types of DCIS may simply be a warning that one or both breasts are at increased risk of developing invasive disease. Such a conclusion would argue for a systemic rather than local therapy as has been suggested by Esserman [8].

Most intriguing is whether future medical therapy will make diagnosis of small node negative disease unnecessary. The recent explosion of subtyping breast cancer using microarray gene expression studies to predict aggressiveness and possible treatment strategies is changing oncologic practice and hopefully improving breast cancer survival. If indeed there is a future when targeted chemo- or immunotherapy is so effective it can eradicate large or bulky or widespread metastatic disease without nasty side effects, then the effort to find small node, negative disease may become unnecessary. Still it is hard to imagine preferring to wait until disease is widespread and bulky before undertaking therapy.

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Time to modernize breast cancer screening?
a mini-review of the Malmö Breast Tomosynthesis Screening Trial

The Malmö Breast Tomosynthesis Screening Trial is a large population-based screening trial designed to evaluate the use of one-view breast tomosynthesis, with reduced compression force, as a stand-alone screening modality. Initial results show a substantially increased cancer detection rate compared to mammography and a still-acceptable elevation of the recall and false-positive rates.

HE NEED FOR A MORE SENSITIVE METHOD
Mammography has been the established breast cancer screening modality for several decades. Nevertheless, the sensitivity of mammography is known to be limited, mainly due to overlapping tissue obscuring tumors, especially in dense breasts [1, 2]. Recent results from several large screening trials evaluating the use of breast tomosynthesis (BT) in screening suggest that this approach may be game-changing and could open up the prospect of modernizing the breast cancer screening programme using a more sensitive method.

BT is a development of the mammographic technique which has the potential to reduce the detrimental effect of overlapping tissue. This is achieved by the X-ray tube being moved in an angular arc over the breast so enabling multiple low-dose projections to be acquired. These projections are then reconstructed into an image volume parallel to the detector plane and consisting of a stack of thin slices, typically of 1 mm thickness. BT images can be obtained using the same views as in conventional mammography, but are usually confined to two views, namely craniocaudal (CC) and mediolateral oblique (MLO).

Even if the role of BT in clinical practice may not yet have been fully established, it is already clear that it could be a valuable clinical tool. The higher accuracy of the technique [3] and its improved tumor visualization, can, for example, result in enhanced pre-operative staging (e.g. tumor size, multifocality) [4] and also in avoiding the “pseudo-lesions” generated by the superimposition of tissues in mammography.

Furthermore, and most importantly, in view of the known limitations of mammography on the one hand and the characteristics of BT as a more sensitive, reasonably cheap and fast modality on the other, the role of BT in breast cancer screening has become of increasing interest.

THE Malmö BREAST T omosYNTHESIS SCREENING TRIAL
The MBTST is a prospective population-based screening trial whose aim is the comparison of the performance of one-view BT with that of two-view digital mammography (DM) in breast cancer screening. The trial started in 2010 and in 2015 the planned total enrolment of 15,000 women was achieved. Women eligible for the screening programme of the City of Malmö, that is of age 40–74 years, were randomly invited to participate. The trial was designed as a one-arm study where participating women underwent both BT (MLO) and DM (CC + MLO) in the same session using a Siemens Mammomat Inspiration system, which is one of the BT systems with the widest acquisition angles (50°). The BT images were acquired with reduced compression force (approximately 50% reduction). Since BT was carried out in only one view the total average glandular dose (AGD) was lower in BT compared to two-view DM (1.6 mGy vs. 2.4 mGy).

The BT and DM images were read by a total of five breast radiologists in two independent reading arms, with blinded double reading. Each reading arm had three reading steps [Fig. 1]. In each step, the radiologist assigned a 5-level score: normal was assigned a score of (1), a benign finding (2), a non-specific finding with low probability of malignancy (3), findings suspicious of malignancy (4), and finally findings highly suspicious of malignancy (5).

If there was a positive score (3 or higher) in any of the reading steps, the case was assigned to an arbitration meeting where at least two readers re-evaluated the images and decided whether to recall the woman for further work-up, irrespective of the score in the other modality.

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So far, results from the first half of the study population (7,500 women) have been analyzed with regard to cancer detection rates, recall rates and positive predictive values (PPV) for the two reading arms, as assessed by needle biopsy, surgery, at a minimum of one-year follow-up and through record linkage with the South Swedish Cancer Registry [5]. McNemar’s test was used to analyze the paired binary data for recall and cancer detection rates. The cancers were also characterized in terms of radiographic appearance and histological type and grade. In a recently published paper, false positives (FPs) were investigated for this population [6]. A FP result was defined as a woman who had been recalled but who was considered disease-free after assessment at a minimum of 3-year follow-up. The FPs were assessed using several parameters, including FP recall rate after arbitration, the radiographic finding leading to the recall and the outcome of the work-up. Differences in the characteristics of FPs recalled on BT alone and DM alone were analysed using Chi-2 and Fisher’s exact test.

**SUMMARY OF THE FIRST RESULTS**

An overview of the first half of the study population and the performance of BT and DM is presented in Figure 2. In summary, 68 of the 7,500 women had a screen-detected breast cancer. These cancers were detected on both BT and DM (n=46), on BT alone (n=21) and on DM alone (n=1). Notably, all cancer cases received a positive score in the first reading step in the separate reading arms, i.e. one-view BT alone and two-view DM alone, respectively. This resulted in a detection rate of 8.9/1,000 screens (95% CI 6.9 to 11.3) for one-view BT as a stand-alone modality and 6.3/1,000 screens (95% CI 4.6 to 8.3) for two-view DM (p<0.0001), which represents a 43% increase in the cancer detection rate.

The 21 additional cancers detected on BT, of which 17 were invasive, did not differ significantly from the DM-detected cancers. However, the former tended to be more of histologic grade 1, lymph node negative, and of smaller size than DM-detected cancers, suggesting a downstaging. An example of a cancer detected by BT alone is shown in Figure 3. Contrary to what we expected the additional cancers were found not only in women with dense breasts but also in fatty breasts, suggesting that the overall lesion conspicuity increases with BT. However, more biological data is needed in order to draw any firm conclusions which hopefully the upcoming analysis of the whole MBTST population will provide.

The recall rate after arbitration was 3.8% (95% CI 3.3 to 4.2) for BT and 2.6% (95% CI 2.3 to 3.0) for DM (p<0.0001). The increase in recall rate for BT was a result of the increased cancer detection but also in the slight increase of FPs. However, the recall rate for BT was still low and well within European guidelines. The FP recall rate was 1.7% for BT alone (n=131), 0.9% for DM alone (n=69), and 1.1% for FPs recalled on both modalities (n=81). Importantly, the FP rate for BT alone was halved after the initial phase of the trial (1.5 years), stabilizing at 1.5%. Hence, a clear learning curve resulting in increased specificity for BT was observed. Furthermore, BT seemed to be especially sensitive for stellate radiographic patterns resulting in more cancers as well as FPs, where the latter included radial scars and postoperative scar tissue [Fig. 4].

**PUTTING THE RESULTS IN CONTEXT**

To date there have been three prospective population-based screening trials which have evaluated the use of BT in screening. Besides the MBTST, the Oslo Tomosynthesis Screening Trial (OTST) and the Screening with Tomosynthesis or Mammography (STORM) trial have presented interim and final results, respectively [7; 8]. However, the OTST and STORM trials both have a fundamental different design compared to the MBTST, since they both evaluate the addition of two-view BT to two-view DM (so-called combination mode) vs. two-view DM alone. Thus, MBTST is the only study that evaluates BT in only one-view as well as BT as a stand-alone modality. The idea behind the MBTST design was to find a rational screening method, which besides providing increased diagnostic performance should also be relatively rapid to carry out in practice. Despite the different designs of the three trials, a similar, significant increase of 30–40% in cancer detection rate was observed. The OTST and the
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MBTST showed similar increase in recall rate, which might be expected with very low baseline recall rates. The STORM trial, however, had lower recall rates for the combination mode compared to DM. The different cut-off-levels used for a recall should always be kept in mind especially when comparing results from United States trials. Several retrospective screening trials in the US have shown a significant reduction in recall rates using the combination mode vs. conventional DM. However, these results cannot unconditionally be extrapolated to a European setting since, in general baseline recall rates are much higher in the US than in Europe.

FUTURE CHALLENGES

One of the main challenges in using BT in a community-based screening programme will be the increased reading time, which will add to the radiologists’ workload and require more resources. Even if only one-view BT is applied the reading time will most likely be doubled. Further research is needed to find efficient reading strategies and/or image presentations. IfComputed-Aided Detection (CAD) is further developed for BT, this could be a practical solution to the issue of reading time by enabling a change from a double-reading protocol to single reading combined with CAD, or by using CAD to eliminate clearly normal images.

Furthermore, the future prospect of a personalized screening programme might result in only a defined subgroup of women undergoing BT screening, while another subgroup can continue using DM, for example women with very low breast density. The MBTST was not designed to assess screening efficacy in terms of effect on breast cancer mortality. In order to do so a very large randomized controlled trial with a long follow-up would be needed. Instead, as part of the forthcoming analyses at the completion of the MBTST, we intend to use interval cancers as a surrogate endpoint for screening efficacy. With the availability of more tumor biological data the additionally detected cancers will be analyzed using clinically established parameters and oncogenic profiling, in an attempt to answer to what extent BT is adding to overdiagnosis. Finally, a cost-benefit analysis of BT screening will be performed, since a screening modality should not only be simple, safe and sensitive, but also affordable.

IMPLICATIONS FOR SCREENING PRACTICE

The clinical implications of the MBTST could be considerable in that preliminary data suggest that one-view BT, with reduced compression force, could replace DM in breast cancer screening. The forthcoming analysis of the whole MBTST population should determine whether this hypothesis holds true.

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FIGURE 3. A cancer detected on BT alone. A 66-year-old asymptomatic woman recalled for suspect findings only on BT. A 15-mm invasive ductal carcinoma, histological grade 1 and lymph node negative, was diagnosed at histological examination. Reproduced from European Radiology with permission.

FIGURE 4. Stellate radiographic pattern, BT is more sensitive than DM in the detection of malignant and benign lesions with a stellate radiographic pattern, here exemplified by an invasive ductal carcinoma grade 2 (upper row) and a radial scar (below) visible on BT (left) but not on the corresponding DM view (right).
Tomosynthesis is the breast cancer screening and diagnostic modality that acquires images of a breast at multiple angles during a short scan. The individual images are then reconstructed into a series of thin, high-resolution slices typically 1 mm thick.

A tomosynthesis dataset greatly reduces detection challenges associated with overlapping structures in the breast, which is the primary drawback of conventional 2D analog and digital mammography.

By the end of 2015, Hologic, the leader in breast tomosynthesis [1], had installed approximately 3,600 breast tomosynthesis systems worldwide [2]. Many sites using the Hologic tomosynthesis system have purchased Hologic’s C-View software which generates a 2D image from the tomosynthesis dataset, avoiding the need for a separate 2D exposure. Eliminating the 2D exposure saves time and makes the dose of a Hologic 3D mammography exam comparable to that of a conventional 2D exam.

Clinical studies, including the landmark JAMA study, “Breast Cancer Screening Using Tomosynthesis in Combination with Digital Mammography,” found that Hologic breast tomosynthesis exams resulted in a significant increase in Positive Predictive Value (PPV) for biopsy versus conventional 2D mammography [3]. PPV for biopsy is a widely used measure of the proportion of women having a breast biopsy who are found to have breast cancer.

Unfortunately, suspicious areas found with breast tomosynthesis exams may be occult in other imaging modalities (conventional 2D mammography, ultrasound, breast MRI), or better seen with tomosynthesis. There clearly is a need for a biopsy system capable of targeting these hard to image areas. This need is answered with the Affirm upright and prone biopsy systems from Hologic.

**TOMOSYNTHESIS TARGETING CAPABILITY IN AN UPRIGHT BIOPSY SYSTEM**

In 2014 Hologic introduced the Affirm upright breast biopsy guidance system allowing users to target areas only found with 3D Mammography exams. The Affirm upright system with Hologic’s 3D Breast Biopsy offered faster targeting, lower dose, and superior performance when compared to conventional stereotactic biopsy systems [4, 5].

The Affirm upright system is an add-on to the Hologic Selenia Dimensions mammography system, allowing the same room to be used for screening, diagnostic and biopsy procedures [Figure 1]. Because the biopsy system uses the same imaging platform as the screening system, areas of suspicion seen in a mammography exam are quickly and easily targeted.

**TOMOSYNTHESIS TARGETING CAPABILITY IN A DEDICATED PRONE BIOPSY SYSTEM**

During 2016 Hologic is introducing the commercial availability of the Affirm prone biopsy system, the first dedicated prone biopsy system capable of both stereotactic and tomosynthesis-guided breast biopsies. The Affirm prone biopsy system is CE marked and is pending 510k clearance in the U.S. [Figure 2]

The new system complements Hologic’s Selenia Dimensions mammography system and Affirm upright biopsy system to ensure that facilities have all the options necessary to provide minimally invasive breast biopsy to their patients.
The Affirm prone system provides enhanced biopsy performance over existing prone systems with:

- Exceptional biopsy imaging capabilities using the same detector technology as the Hologic tomosynthesis mammography system.
- A streamlined workflow designed to make the use of the system fast and easy.
- Access to challenging lesion locations with a fully integrated C-arm. The C-arm allows a full 360° access to the breast with both standard and lateral needle approaches—without requiring additional accessory attachments.

The Hologic Affirm upright and prone biopsy systems push the boundaries of breast care. With their dual stereotactic and groundbreaking tomosynthesis biopsy capabilities, radiologists can now easily locate and target regions of interest for biopsy, delivering streamlined workflow, accurate targeting and exceptional images.

REFERENCES

Book review

Women’s Imaging: MRI with Multimodality Correlation
Edited by Michele A. Brown, Haydee Ojeda-Fournier, Dragana Djilas, Mohamed El-Azzazi, Richard C. Semelka
Pub by Wiley-Blackwell 2014; 384 pages €158

Women’s imaging refers to the use of imaging modalities (X-ray, ultrasound, CT scan, and MRI) available for aiding in the diagnosis and care of such female-centric diseases as cancer of the breast, uterus, and ovaries. Currently, there is no single reference source that provides adequate discussions of MRI and its important role in the diagnosis of patients with women’s health issues.

Thoroughly illustrated with the highest-quality radiographic images available, Women’s Imaging: MRI with Multimodality Correlation provides a concise overview of the topic and emphasizes practical image interpretation. It makes clear use of tables and diagrams, and offers careful examination of differential diagnosis with special notes on key learning points. Placing great emphasis on magnetic resonance imaging (MRI), while providing correlations to other important imaging modalities,

The book will appeal to all general radiologists – especially those specializing in body imaging, breast imaging, and women’s imaging – as well as gynecologists and obstetricians, breast surgeons, oncologists, radiation oncologists, and MRI technologists.
Towards Enhanced Reproducibility and Understanding of Prostate Cancer through Standardised MRI Acquisition, Analysis and Reporting

Standardised image acquisition and comprehensive automated analysis of multi-parametric Magnetic Resonance Imaging (mpMRI) are crucial in prostate cancer for optimal diagnosis and therapy and improving patient outcome. There is a clear need for computer-aided analysis and for software which can support clinical workflow to enable faster, more quality-controlled analysis and the extraction of both functional and anatomical information on suspicious lesions. The Dynamika software package, developed in collaboration with leading researchers, radiologists and urologists at UCL, London has been designed to meet this challenge and provide more accurate diagnosis, staging and monitoring of prostate cancer.

The Role of MRI in Prostate Cancer
Prostate cancer (PCA) is the second most common cancer in men worldwide. The serum level of prostate-specific antigen (PSA) has been widely used for screening since the early 1990s. If after digital rectal examination, a cancer is suspected a biopsy is required. PSA, however, remains a controversial method of choice as it has poor sensitivity and an unacceptably low specificity [1]. In addition, the low-cost 12-core transrectal ultrasound (TRUS)-guided biopsy routinely misses and underestages cancers [2]. As a consequence, too many patients are still being unnecessarily treated for indolent cancers.

Technological advances in MR sequences over the last few decades have resulted in significant improvements in MRI so that it is now a pivotal modality in prostate cancer management.

Multiparametric Magnetic Resonance Imaging (mpMRI) combines anatomical images from T2-weighted imaging (T2wI) with functional sequences:
- diffusion-weighted imaging (DWI), which quantifies the microscopic mobility of water molecules in tissues, and the apparent-diffusion coefficient (ADC) derived from it.
- dynamic contrast-enhanced (DCE) MRI, which is based on the permeability of blood vessels and extravasation of contrast agent into adjacent tissue.

While high-resolution T2wI provides the best assessment of the prostate's morphology, margins, and internal structure, DWI brings specificity, and DCE adds sensitivity, together making mpMRI especially effective in revealing anterior prostate cancer in men with negative random TRUS-biopsy [3].

MpMRI offers considerable information on prostatic lesions including the localisation, characterisation, size and volume, aggressiveness, and staging. Such an approach increases the positive predictive power of PCA diagnosis [4] and is becoming more and more integrated into the complete management of prostate cancer.

MpMRI is used today in the various stages of diagnosis and treatment pathway, helping clinicians to distinguish patients requiring treatment from those ‘only’ needing monitoring, and to define the most appropriate therapeutic strategy. Its role is spreading from detection to targeted (MRI-)guided biopsy, active surveillance (AS), focal/radiation therapy, and surgery — from planning to follow-up.

Need for Standards
Despite all the possibilities and potential that prostate mpMRI may offer, the broad and consistent adoption of the technique in clinical routine is not occurring without some difficulties.

Firstly this is because frequently from hospital to hospital the actual MRI sequences used can vary. In 2012, however, clinical guidelines for mpMRI of the prostate were published by prostate MRI experts such as those in the European Society of Urogenital Radiology (ESUR). Based on literature evidence and expert opinion, these guidelines aim to promulgate high quality mpMRI by providing consensus about the optimal requirements for acquisition, protocols for detection and staging, and evaluation with the correct indications for prostate cancer [5].

A second hurdle is the challenge of presenting a large amount of information and combining the various findings into a simple and comprehensive interpretation. Large or high-

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grade cancers tend to be well visualized on all sequences. Small, diffuse, or lower-grade lesions, on the other hand, may display discrepancies between different sequences, leading to a wide scope of possible interpretations, possible conflicting or inconsistent findings between different reporters and different diagnostic centers. Structured pathology reports, with standardised definitions for each component, have been shown to significantly enhance the completeness and quality of data provided to clinicians.

The introduction of the Prostate Imaging Reporting and Data System (PI-RADS) v1 by ESUR in 2012 and the updated v2 in 2014 by the joint steering committee formed by ESUR, the American College of Radiology (ACR) and AdMeTech Foundation, increases the potential for improved patient outcomes, through the establishment of standards for mpMRI acquisition, interpretation, and reporting, as well as enhancing the communication between practicing radiologists and clinicians [6].

**NEED FOR SUPPORTIVE TECHNOLOGIES**

Another problem is that prostate cancer management involves multiple health actors resulting in mpMRI being used at various stages of treatment: before biopsy; after biopsy; as an image guide for targeted biopsy; as a technique to monitor disease progression or the effect of treatment; or as a method to plan radiation and other focused energy therapies. Adequate infrastructure and supportive technologies are needed, to convey data and information, to facilitate analysis and structured reporting and communication in a fast, cost-effective and easy manner between all persons involved, including the patients themselves.

**Easing Complex Data Presentation and Review.**

The understanding and interpretation of the different MRI volumetric sequences require a high level of expertise and is time-consuming. Conventionally, individual sequences are “mentally” fused and aligned to enable a joint assessment. For an untrained user, such process is very time consuming and prone to errors. The Dynamika software [7] addresses this challenge through a customisable user interface, in which individual mpMRI sequences can be laid out, registered and displayed in a spatially synchronized manner to provide the user with a view of the data where cancer can be easily assessed. In addition the software enables consistent reading across cases.

Processing tools are also available. These include image normalisation – particularly on T2wI, used to reduce interpatient variability of MR intensity values – and the computation of derived maps from raw data, displayed as overlays. For PCa, the recommended data presentation should include T2wI; high b-Value DWI (carcinomas display hyperintensity when $800 \leq b \leq 1000 \text{ s/mm}^2$); ADC map from DWI (carcinomas have reduced ADC, computed using preferably mono-exponential model) and DCE data (with at least signal intensity over time curve type classification map – for v1).

As shown in Figure 1, a coronal T2wI localiser – acquired or recomputed – is added to the T2wI, high b-value, ADC, DCE, and Washout-Time map overlaid on DCE, axial synched slices. The Dynamika software allows the computation of an ADC map from a DWI dataset if it is not already provided within the study. Furthermore, Regions-Of-Interest (ROIs) defined in a view are instantaneously propagated, mapped, and can be modified in the other views, with the relevant pixel value statistics being available.

**Optimising (Structured) Reporting and Communication of Findings.**

The benefits of proforma type reporting have been widely acknowledged, and the PI-RADS standardised graphic prostate scheme and scores aim to harmonise the reading and communication of the findings. Nevertheless, assessing multiple lesions by mapping subjective interpretations of different images into a standardised score and localising each one on predefined prostatic regions, requires both a high level of expertise and time.
The introduction of interactive PI-RADS report forms in the Dynamika software allows readers to experience a direct connection between the images and the reporting sheet. Images, ROIs and reports are no longer detached, and instant feedback in the report can serve a better understanding and analysis of the images.

As shown in Figure 2, not only are the scans within a study synchronized spatially, but Dynamika also links manipulations such as zoom and pan to retain a coherent presentation of information between the MR sequences. Upon review, the user can open a window of the interactive PI-RADS form, in which the synchronised ROIs are listed to be assigned to a specific sector defined by the standardised prostate regions diagram. The PI-RADS form is regularly updated with the most recent research updates in line with PI-RADS v1 and v2 and include PSA, prostate and lesion volume, biopsy results, Gleason score, extracapsular extension, seminal vesicular invasion, lesion scores, DWI results, and 2D visualisations. In addition, the customisable user individual interface allows for adjustments for both PI-RADS updates as well as for user-specific preferences.

Advances in computer aided-diagnosis (CADx) could offer decreased reading time and consistent risk assessment of cancer presence. Evaluation of the principal current CADx systems for "Prostate Cancer Diagnosis" has unfortunately shown that they are not fully ready yet. Improvements will be made over the next decade and the wide deployment of prostate CADx systems in the clinical environment will eventually occur [8]. In the meantime, more focused applications for suspicious lesion detection, localisation and description, based on the combination of T2wI, DWI and DCE, could help readers efficiently grade and report lesions in PI-RADS form. This is an area in which the company Image Analysis, developers of the Dynamika software package, is actively involved.

**Enabling Advanced Quantitative Analysis.**

Advanced quantitative analysis and colour maps based on DCE (parametric maps, pharmacokinetic parameters, subtraction, See Figure 3.) are also available and novel methods developed either by in-house research, collaborations, or external innovators – are continually integrated into the Dynamika software to aid lesion classification. These quantitative outcomes may be linked to PI-RADS scores for lesions and therefore allow a more precise monitoring for a specific lesion.

**Facilitating Disease and Treatment Monitoring.**

The ability to quantify 'evolution' over time is key in active surveillance or treatment monitoring. Imaging biomarkers are used to categorise lesions, measure disease progression or estimate doses for focal radiotherapy as well as guide biopsies. Multiple images of multiple time series need to be compared. This is difficult from a viewing perspective as well as from a timing aspect. The time-consuming task of comparison of a current image with a prior is automated. All datasets and reports are stored in one central database, easily and rapidly accessible from any computer connected to the internet. Further, the software organises the arrangement of the individual scans in an intuitive way and allows easy identification and propagation of ROIs between scans and studies.

**CONCLUSION**

MfMRI is growing in many areas of PCa management, as a result of the constant efforts of clinical research communities to promulgate and refine standards for acquisition, interpretation and reporting. The value and richness of the multi-parametric approach is undeniable in oncology, and mpMRI offers hopes and opportunities to further expand the understanding of PCa mechanisms, provide better detection and staging of lesions, evaluate therapeutic effects more efficiently and deliver more focused and personalised treatments.

Technology needs to adapt and offer better, easier and faster ways to present and analyse ever-larger and more complex clinical data. In the current era of evidence-based medicine, technology also needs to provide platforms to allow multi-disciplinary and multi-site/national collaborative research to investigate, evaluate and validate new treatments, quantitative imaging markers, or computer aided-diagnosis tools for PCa. Dynamika is such a dedicated cloud platform [9] developed for and in collaboration with researchers, radiologists and urologists. By incorporating the latest standards and keeping abreast of science, Image Analysis aims at improving quality and efficiency, and ensuring reliability and reproducibility of PCa diagnosis and treatment from more and more complex mpMRI data.

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INDUSTRY NEWS

GE bets big on the Cloud

The recently launched Health Cloud from GE Healthcare has been designed exclusively for the healthcare industry. The new cloud ecosystem and its applications will connect radiologists and clinicians to speed, efficiency and collaboration across care pathways and multidisciplinary teams – both inside and outside the hospital setting.

“Our ultimate goal is to help improve patient care and drive superior clinical, financial and operational outcomes alongside healthcare providers,” said Jeff Immelt, Chairman and CEO of GE. “As the digital industrial leader, we are betting big on the GE Health Cloud. By connecting clinicians with the insights needed, when and where they need them, they can take action to improve healthcare outcomes and delivery around the globe.”

Today, survey data shows that up to 35 percent of patient cases are misdiagnosed, partly due to a lack of access to images, data and records. Industry consolidation and cost pressures are squeezing margins and pushing providers beyond hospitals four walls. The interoperability of systems could save healthcare ecosystems many billions of dollars per year billion per year. The cloud-based apps quickly connect clinicians with imaging, data, analytics, insights – and other clinicians – to increase efficiency, effectiveness and collaboration.

“Healthcare devices are generating enormous amounts of data, and the amount of data is expected to increase 50-fold by 2020,” said John Flannery, President and CEO for GE Healthcare. “The GE Health Cloud can help unlock the value of this data, quickly and seamlessly for better patient care. The GE Health Cloud will help clinicians turn data into insights, and insights into tangible actions for decision-makers to drive better outcomes."

The new cloud will connect to more than 500,000 GE imaging machines, shifting image post-processing from on-site machines to the cloud. From the cloud, 3-D images can then be viewed on multiple devices – inside and outside the hospital setting. The GE Health Cloud and apps will give clinicians on-demand, flexible computing power that can scale up or down.

By opening its cloud for third party app development, GE intends to attract independent software vendors (ISVs) to develop their apps in the new cloud ecosystem.

Currently available apps include:
- Centricity Cloud Advanced Visualization. This app will manage image post-processing and allow radiologists and clinicians to view advanced 3-D images anytime, anywhere.
- Centricity Multi-Disciplinary Team Virtual Meeting – This app will help multidisciplinary teams carry out collaborative care planning, ultimately helping radiologists and pathologists reduce the time they spend preparing for meetings by up to 20 percent.
- Centricity Case Exchange – This app provides affiliated and non-affiliated systems to share images and reports and quickly confer on patient cases and treatment plans.
- Centricity Image Access Portal. - This app provides affiliated and non-affiliated physicians with longitudinal patient imaging data, potentially improving turnaround times for patient reports. 
- Apps on the GE Health Cloud will be delivered on a subscription basis, enabling hospitals and health systems to shift computing expense to a variable cost model. The cloud ecosystem will include a robust Software Development Toolkit (SDK), and its app store will host and promote new software solutions.

GE HEALTHCARE
CHALFONT ST GILES, BUCKS, UK
www3.gehealthcare.com

Ultra high frequency ultrasound system gets CE Mark

FUJIFILM VisualSonics Inc., a leader in ultra high frequency ultrasound imaging systems has announced that the Vevo MD, the world’s first Ultra High Frequency (UHF) clinical ultrasound system has been granted the CE mark. This marks a major milestone for FUJIFILM VisualSonics as it expands into the clinical market.

“As the undisputed leader in ultra high frequency imaging systems, FUJIFILM VisualSonics once again advances the field of ultrasound with the launch of the Vevo MD,” said Masayuki Higuchi, president & CEO, FUJIFILM SonoSite, Inc. “We are proud to be the first to bring to market this exciting innovation that is sure to have high impact on the medical imaging community while expanding the product portfolio of FUJIFILM SonoSite.”

The Vevo MD is truly a unique ultrasound system, as it operates at much higher frequencies than any conventional ultrasound system currently available. Along with the Vevo MD system, FUJIFILM VisualSonics has also introduced the UHF Series of transducers. This patented transducer technology is capable of operating in a range of frequencies up to 70 MHz, giving a tremendous increase in resolution compared to conventional ultrasound systems.

“The Vevo MD allows medical professionals to see what they have never seen before—unparalleled image resolution down to 30 micrometers. This is less than half the size of a grain of sand,” said

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OnTrack. OnTarget. OnBudget.
Renaud Maloberti, vice president & general manager of FUJIFILM VisualSonics. “Imagine the great potential this technology has across unexplored applications to visualize the smallest, highly detailed anatomy in a way that has never been done before.”

“We believe this technology has a role to play in a range of clinical application areas from neonatology, vascular, musculoskeletal, dermatology, or other small parts that are within the first 3 cm of the body,” said Andrew Needles, director of marketing at FUJIFILM VisualSonics. “We also know that there are new and interesting areas to be discovered. The Vevo MD gives us and our users the opportunity to make those discoveries together.”

The Vevo MD is now commercially available in the majority of European Union countries.

FUJIFILM VISUALSONICS, INC., TORONTO, CANADA

Number of Patents show activity of Carestream’s R&D efforts

In 2015 Carestream Health was awarded 61 new patents from the U.S. Patent and Trademark Office for innovations in radiography, cone beam CT imaging, healthcare IT, dental imaging and other areas. The company also received 64 additional patents in countries from the U.S. Patent and Trademark Office as well as 34 patents in countries outside of the United States.

The year before last, namely 2014, Carestream was awarded 66 patents from the U.S. Patent and Trademark Office as well as 34 patents in countries outside of the United States.

New patents earned by the company’s scientists and engineers include:

- New image capture technologies related to the development of cone beam computed tomography (CT) systems designed for orthopedic extremity imaging;
- Enhancements to Carestream’s proven portfolio of healthcare IT systems that manage, store and share patient data and medical imaging exams;
- Continued technology advances in Carestream’s growing portfolio of radiology systems that can enhance medical image quality for a wide range of healthcare providers;
- New technology and features for dental imaging, dental image processing and software and dental restoration systems;
- Continued developments in Carestream imagers and media that provide affordable printing of digital X-ray exams onto medical film and paper.

The company’s product portfolio includes digital imaging systems for general radiology and specialty areas such as women’s health, orthopedics and pediatrics; digital imagers that output medical images to film and paper; and the latest healthcare IT solutions and cloud-based services for hospitals, clinics and physician practices. Carestream’s Dental division develops and markets film and digital imaging solutions, anesthetics and practice management software.

“The advantage of offering this print-on-demand service to Vital’s global hospital and imaging center customers is that they can have best-of-breed technology available at their fingertips without first acquiring a 3D printer,” said Jim Litterer, President and CEO at Vital. “In addition, they can have these capabilities using the software they are already accustomed to using in their daily practice.”

“We understand the importance of streamlining the use of 3D printing in the clinical setting,” said R. Scott Rader, General Manager, Medical Solutions at Stratasys. “Partnering with Vital to integrate our 3D printing capabilities leverages the strengths of the two companies, with the mutual goal of improving patient care and providing clinicians with the tools they need, when they need them.”

Stratasys’ Objet260 Connex3 3D Printer supports simultaneous multi-material, multi-color 3D prints to mimic both the appearance and texture of patient anatomy, whereas Vital’s Vitrea software takes patient scans and converts them into STL files for direct use with the 3D printer. The combination allows a range of anatomical models to be printed from actual patient studies.

Headquartered in Minneapolis, Minnesota and Rehovot, Israel, Stratasys, Ltd., has been a defining force and dominant player in 3D printing and additive manufacturing for more than 25 years.

VITAL IMAGES,
MINNEAPOLIS, MN, USA
www.vitalimages.com
Siemens again sponsors Breast Care Day at ECR 2016

In what is now becoming a tradition at ECR, the Breast Care Day promises to again be the premiere event at the ECR. Organized and sponsored by Siemens in cooperation with Bayer Healthcare, the meeting focuses on new and improving diagnostics for breast cancer. The combination of daily routine reports, new studies, a future outlook and open discussions has attracted more than 5000 customers over the last 5 years to this program. This year, the Breast Care Day (2nd Mar) will feature four separate symposia given by experts in the field, namely on MRI - Today and Tomorrow; Breast Screening Controversies; Digital Breast Tomosynthesis, out of the Daily Routine and finally Breast Imaging for Therapy Control.

Siemens Healthcare
Erlangen, Germany
www.siemens.com

HIMSS Analytics Europe ramps up data collection in France

HIMSS Analytics in Europe has announced it will start data collection in France in order to enable hospitals to understand and improve their level of digital maturity. The national initiative “Programme Hôpital Numérique” with the goal to digitise all hospitals will end in 2017, so this is the right time to measure where hospitals are at the moment and what still needs to be done within the remaining two years.

HIMSS will enable hospitals to use its EMR Adoption Model (EMRAM) at no cost, in order to identify the levels of electronic medical record (EMR) capabilities ranging from stage 0 which demonstrates clinical IT support being mostly limited to departmental systems, up to stage 7 with a paperless patient record environment that enables improved quality of care and better organizational performance.

Jörg Studzinski, Senior Consultant at HIMSS Analytics in Europe said: “The model is used by more than 8,000 hospitals around the world. It enables healthcare providers to strategise their path to become a digital hospital and enables the identification of best practice where hospitals, using a globally standardised assessment methodology, can learn from each other and improve care delivery for their patients.”

Each hospital participating in the assessment will receive their EMRAM score and a gap analysis that highlights missing applications and processes to improve the organization’s Electronic Medical Record system and achieve higher EMRAM stages. In addition hospitals will be able to compare themselves with other hospitals in France and with leading healthcare providers in Europe and across the world.

By completing the evaluation, the organization will become member of the HIMSS French Community and have access to key insights, best practice, education and a network that supports each other to improve the delivery of care. Being part of that community will also enable hospitals to receive member rate discounts to all HIMSS events in Europe.

Additionally, the organization will have the possibility to share their healthcare IT success story through Health IT Central, the HIMSS Europe media platform which publishes the latest of European health IT news and views on one simple website.

HIMSS Analytics Europe
Leipzig, Germany
www.himssanalytics.eu/

SyntheticMR and Philips sign cooperation agreement

SyntheticMR develops and markets software solutions for MRI. The company has announced that its SyMRI software will now be compatible with most of Philips’ MRI scanners to help enhance workflow efficiencies and clinical decision support. SyntheticMR and Philips have signed a cooperation and co-marketing agreement, as part of which Philips will offer the SyntAc sequence as optional software to customers, making most of Philips’ MRI scanners compatible with the SyMRI post processing software packages offered by SyntheticMR.

With SyMRI packages from SyntheticMR, the data generated from a single SyntAc scan can be turned into multiple image contrasts, having workflow and time saving benefits. Moreover, the contrast can be adjusted after the scan, creating additional images without re-calling the patient. Automatic segmentation of brain tissue provides objective decision support based on quantitative data.

“I am very pleased that customers using most Philips MRI scanners will now have access to SyMRI, expanding our software packages to a broader, global customer base and enabling them to explore new imaging strategies and efficient quantification capabilities,” says Stefan Tell, CEO of SyntheticMR.

SyMRI is available in three product packages. SyMRI IMAGE is dedicated to optimized workflows and short scan times using synthetic MRI. SyMRI NEURO adds quantitative data, providing efficient analysis and objective decision making for brain imaging. SyMRI Research Edition is optimized for clinical research within neuro imaging. Quantitative T1, T2 and PD maps (SyMaps) can be saved and exported for further analysis in other formats.

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Overcoming workflow inefficiencies with a single, integrated Advanced Visualization platform

In a recent web-based seminar accessed by interested radiologists throughout the Middle East and Europe, Prof Charbel Saade gave a hands-on demonstration of how the implementation of an Advanced Visualization software platform has brought about significant workflow efficiencies in his radiology department. Prof Saade highlighted how continuing innovations in Healthcare IT can significantly affect the operational efficiency of hospitals and showed best practice workflows for certain oncology and cardiac clinical cases.

This article summarizes the series of practical presentations showing how Prof Saade currently uses the IntelliSpace Portal from Philips for multi-modality tumor tracking, CT transcatheter aortic valve implantation (TAVI) planning and CT liver segmentation, and demonstrates the real improvements in his department’s work-flow that the software package brings.

Traditionally, radiology has been considered as a discipline devoted to the processes of detection and diagnosis in the implicit belief that accurate and rapid implementation of detection and diagnosis should result ultimately in better patient care. In fact, the role of radiology is much more central than this. Radiology is at the heart of — and has applications in — the whole health continuum, ranging from healthy living, prevention, diagnosis treatment, through to recovery and home care. Radiology is already playing an active role in fields outside pure diagnosis, for example in therapy-guidance.

Before describing the full potential of advanced visualization systems it is important to be clear about the difference between PACS systems and advanced post-processing systems.

PACS, with which all radiologists are familiar, is the workhorse of radiology; here information is extracted from the images which are stored in the format in which they were received. However these images may contain questionable areas, for example depending on the thickness of the slices. Whereas PACS presents images in a plane, advanced post processing systems give full access to all the underlying data which can then be manipulated in any desired plane or resolution. Full utilization of the source data available to the post-processing system can have a dramatic effect on decisions affecting patient treatment, especially in cases where the simple images on the PACS aren’t unambiguously clear.

In practice the situation is complicated by the number of imaging modalities, e.g. MRI, CT, Nuclear Medicine, ultrasound, interventional and diagnostic X-Ray, etc., which generate images, whose particular value depends on the application. No single modality is “better” than the other — they all complement each other. In practice however, in traditional radiology work-flows however, the existence of multiple modalities gives rise to demands for a separate CT work-station, a separate MR work station, one for Nuclear Medicine, not to mention one for the PACS, etc.

This can give rise to significant workflow inefficiencies. For example if a radiologist on the CT work station wants to cross-correlate his observations on the same patient with MRI findings but the MRI station happens to be occupied by a colleague radiologist on another case, then inevitably one or the other will have his work-flow interrupted. Ideally full access to the data should be available whenever and wherever required.

The IntelliSpace Portal from Philips provides such multi-access to the data provided by all imaging modalities [Figure 1, 2]. Not only are all the data available to several users at the same time but the users can be physically located virtually anywhere in the world, allowing second opinions or diagnostic confirmation to be obtained easily and quickly. This is of particular importance with difficult-to-interpret emergency cases, for example during the night when only a resident radiologist may be available and yet vital surgical
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  Alberto Torresin, Milan, Italy
- Patient-centered CT protocols: clinical aspects and practical tips
  Thomas Albrecht, Berlin, Germany

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Friday, March 4
12:30-13:30
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**Gadolinium contrast agent safety: facts and myths**

**Moderator:** Richard Semelka, Chapel Hill, USA

- Acute adverse reactions: what accumulated evidence shows
  Richard Semelka, Chapel Hill, USA
- Nephrogenic systemic fibrosis 10 years on: what conclusions can we draw?
  Johannes Heverhagen, Bern, Switzerland
- Gadolinium deposition: what do we know and should we be concerned?
  Cesare Colosimo, Rome, Italy
- GBCA risk vs. benefit: Q&A panel discussion
  Richard Semelka, Chapel Hill, USA

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Saturday, March 5
12:30-13:30
Room Studio

Bracco Satellite Symposium

**The role of CEUS in liver imaging and patient monitoring**

**Moderator:** Dirk Clevert, Munich, Germany

- CEUS in liver imaging – does it provide added value over CT and MRI?
  Dirk Clevert, Munich, Germany
- Monitoring of Imaging guided Intervention
  Franca Meloni, Como, Italy
- Monitoring of targeted chemotherapy with dynamic CEUS (DCEUS)
  Nathalie Lassau, Villejuif, France

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intervention is needed. The maximum information should be extracted from the images and provided pre-operatively.

This can be carried out using the advanced visualization processes of the IntelliSpace Portal system which can be accessed by the consultant radiologist even if he is not physically in the institution. He can even be abroad at the time.

But it is not just a question of having more access to the data. The system provides the necessary tools for comprehensive evaluation of the dataset and provides functions that just aren’t available on even the most advanced PACS systems.

All this provides real help in clinical decision-making, and at significant work-flow efficiencies.

Here are some examples of where we use the system and the time-savings we get.

TUMOR TRACKING WITH MULTI-MODALITY IMAGING

In oncology one of the main concerns is to monitor changes in lesions as a function of time between patient visits. This can be complicated since generally in oncology there is both a series of CT images, which give a macroscopic anatomical view of the tumor, but also PET images which give a view of the tumor’s metabolic activity. Correlating these images is necessary in order to be able to confidently determine whether the tumor is active and increasing in size with time; this is especially difficult to determine at the early stages of tumor development.

Previously we had to retrieve the images from prior visits via our PACS system and align them side-by-side for comparison. We used to spend hours trying to compare images and it was a nightmare. Now with one click of a button on the lesion, the IntelliSpace Portal system will automatically identify the corresponding lesions in the prior images and also supply a quantitative measure of the confidence in the matching of the lesions [Figure 3]. And the system doesn’t just indicate any long axis changes that are measured when the target lesion is examined, but also short axis changes. Thus, automatically volume changes can be quantified without any need for individual measurement of the different lesion axes and separate calculation of the volume as we used to have to do. In addition to the huge time saving, an important factor is that the results are consistent and can be automatically compared using RECIST criteria. After approval the data can then be popped into the radiology report, in an easily understandable format for the referring physician. The real beauty of the system is that thanks to the quality and reliability of the data the oncologist has much more confidence in the radiology report.

“... We used to spend hours trying to compare images and it was a nightmare. Now with one click of a button...”

CT LIVER ANALYSIS

Considerable work-up is necessary to characterize the liver, starting from a portal venous post-contrast radiological examination. The liver has to be segmented, the volume of each individual lobe determined and the vasculature examined to determine if there are any abnormalities. If any incidental lesions are found, it has to be decided which has to be resected. All in all it becomes quite complex to look at these aspects. Before we had the IntelliSpace Portal, it used to take a total of 60 minutes to quantify the individual lobes of the liver and look at the vasculature supply in and out of the liver. Examining and scrolling through all the images could be tedious: if a lesion was detected, then the workload could increase to even an hour and a half. Now, with the IntelliSpace Portal software, liver segmentation can be obtained quickly and automatically and it is no longer necessary to involve junior radiologists to do preparatory work-up.
The total volume of the liver is immediately available and it can be segmented with one click of a button. If a lesion is detected, a simple click on it will trigger the system to automatically provide its volume and show in which segment(s) it is located [Figure 4]. If it is decided that the lesion should be resected, the surgery planning option in the software is selected. What is important in such a case is to identify the tumor bed, which radio logically is difficult to see.

The software provides a choice of safety margins which are visually represented on the screen so that the surgeon can see the combined volume and position of the lesion and safety margins. All these data are immediately available in resection summary tables.

CT TAVI PLANNING

Transcatheter aortic valve implantation (TAVI) is becoming more and more popular but successful placement requires careful planning, in which the radiologist plays an important role to provide the appropriate dimensioning and positioning of the valve. Preoperative assessment of the aortic annular dimensions is crucial for the success of TAVI; an incorrectly sized prosthesis can result in catastrophic complications. Thus the aortic root anatomy has to be assessed accurately so consistent imaging and measurement is vital. In the past there was considerable work involved in manually carrying out the necessary tasks such as examining the aortic annulus, left ventricular outflow tracts, determining the hinge points, etc.

With the IntelliSpace Portal all of the imaging data are available to the system and with a few clicks of a button the appropriately determined dimensions are presented [Figure 5] When these are accepted by the radiologist, a full report is generated automatically.

The recently launched IntelliSpace Portal 8.0 (introduced at RSNA 2015) is the latest edition of Philips’ advanced data sharing, analytics and visualization platform that helps radiologists detect, diagnose and follow-up on treatment of diseases. The latest update delivers new applications – like fast 3-D quantitative renderings of tumors – in a fully integrated oncology suite to improve diagnostic confidence and patient care. Among the new applications of the system are:

• A new CT Lung Nodule Assessment (LNA) application designed for a more efficient and longitudinal workflow, which features a unique risk assessment tool for clinical decision support.
  • A Lung Nodule CAD, through which radiologists also have access to the computer-aided detection system for chest multi-slice CT exams.
  • A comprehensive pulmonary solution to aid clinicians in measuring and tracking COPD, detecting pulmonary emboli, and performing calcium scoring.
  • Embedded in the entire cardiac workflow, the MR Cardiac Quantitative Mapping enables fast quantification and analysis workflow for T1, T2, and T2 generated maps to enhance the diagnostic view in cardiomyopathies.
  • Enhanced capabilities in the Multi-Modality Viewer allow for the review, editing and analysis of Philips iXR and general radiology datasets. MR Smart Display Protocols deliver the best fitting display protocols for each individual patient based on the radiologist’s preferred initial viewing layouts.
  • With enhanced reporting features, radiologists can augment clinical reports with exportable graphs and tables, which can be collated into a single patient report and stored directly on the PACS or RIS.
Decisions, decisions...

The Contilia Heart and Cardiovascular Center in Essen, Germany is renowned world-wide for the quality of its patient care and research activities. The center has recently decided to implement a new patient-centric, all-in-one cardiovascular information system (CVIS) and is currently in the process of installing it.

We wanted to find out more about the center itself and the decision-making process behind the choice of their new CVIS, so we spoke to Dr Christoph Naber and Dr Olivier Bruder, who head up the cardiology department at the Elizabeth Krankenhaus, a member unit of the Contilia Group of hospitals.

Q. The Contilia Heart and Cardiovascular Center in Essen must be one of the biggest cardiology units in Germany, if not Europe. Please tell us about your Center.

Well in fact, there are three separate hospitals which are part of the Heart and Cardiovascular Center so none of these individual hospitals is the biggest, but taken together we are certainly one of the largest.

Q. Talking of imaging, what modalities do you have?

As you might expect of a modern functional cardiology unit we have all the imaging modalities: MRI and CT from Siemens, echocardiography units from GE and Philips. In addition we have intracardiac imaging possibilities, such as Intravascular ultrasound and OCT.

Q. And what about the high reputation that the unit enjoys? What is that due to?

Yes, in all objectivity, it is true that we do have a good reputation of which we are of course very proud. Not that we take it at all for granted. On the contrary, we work hard to maintain the quality of our services. It is tempting to put the reasons for our good reputation simply down to hard work, but naturally there are many other factors involved in addition to the capabilities of the personnel and the technological power of the equipment we have, although these are of course vital.
One other aspect that contributes a lot to the renown of our center is the number of international research collaborations in which we take part. I spent part of my training in France and many of my colleagues have also spent time in prestigious centers abroad, so we have a large network of international contacts and participate in all the major international congresses. We have trials on-going with centers in the US, China, Singapore, India as well as in Europe.

One objective recognition of the quality of our center is the fact that we are one of only three centers in the world to have been granted the designation of Cardiology Reference Center by Siemens, the other two being in Monaco and Shanghai. The purpose of the collaboration with Siemens is to improve clinical workflows and promote innovative treatment concepts in noninvasive and invasive cardiology. We do have Siemens MRI and CT and also their PACS system for the hospital's general radiology work.

Q. Which brings us on to the decision to invest in a new CVIS system. What was the decision-making process involved?

As I said the hospital’s general radiology department has a Siemens’ PACS system. We have a local hospital information system (from the Meierhofer company) and we had a cardiology information system supplied by a local IT company, which actually functioned quite well, although it needed some serious up-dating. However in an all-too common scenario, the local company was taken over by a bigger international enterprise and — at least as far as we were concerned— could no longer provide the functionalities or service that we were looking for.

So we had to evaluate other possibilities.

Basically what we were looking for was a system that was easy-to-use; that included the databases, which we need for our scientific work; that contained all the the patient information; and finally that contained the images, which of course are very important.

Above all what we needed was an integrated system, that could bring all these elements together and quickly. For example when we are discussing cases, say with the surgeons, we need to be able to show the ECG, the echo images, a CT and MRI all at the same time. And of course we don’t have time to open up different systems separately to show each part of the overall data package. So basically we were looking for a patient-centred system.

There are already other systems out there which could partially meet our requirements, e.g. some data base systems which can also handle a bit of imaging, or image-based systems which can also handle a bit of data.

However there were only a few systems that could really meet our requirements, one of which was Esaote and their Suitestensa system.

We therefore visited several of the centers that already used the Esaote system, in Italy for example and also in South America. When the feed-back there was positive, we finally plumped for Esaote.

Q. So what is the situation now?

Although the basic decision to go with Esaote was taken some time ago, we didn’t actually formally commit to it until relatively recently. This was principally due to in the meantime competitive systems coming up with new updates which we had to evaluate. It’s a big decision so we want to make sure that we get it right. And there are financial aspects involved as well, which have to be carefully considered, for example the cost of interfaces with the current systems. Of course it’s not just a question of choosing the cheapest system, rather it’s a question of choosing the one that best meets our needs of having streamlined integration together with third-party software or modalities and is also cost-efficient.

Early on we decided that we needed images of all modalities to be merged into the new Suitestensa system together with all clinical data so that we can have complete patient documentation easily accessible in one, single system. In addition to this, integration of images and data we wanted advanced processing tools and automatic import into the final reports.

It should be noted that all the decisions regarding the choice of systems were on our part taken collectively, with the appropriately qualified people being asked to give their opinion. For example regarding the interfaces, our hospital IT
people worked closely with the Esaote people to make sure that there would not be any major surprises.

It’s not just the IT people who were involved in assessing the system, since we wanted to make sure that all users could express their opinion and have their say. And naturally everybody has a slightly different perspective. For example some clinical researchers may want sophisticated technical functionalities, whereas for the nurses, ease-of-use is the most important aspect.

However thanks to a commonsense attitude and an ability to look at the big picture all such minor differences in priorities were easily resolved.

But you can’t go on with such a consultative process forever so a formal decision has now been taken and we are actively working to optimally configure the system for our requirements. For example I personally want to make particularly sure that we determine the smallest number of data fields and don’t get tempted to have too many unnecessary fields which could clutter the system.

Then on April 1, we will begin a six-week testing period where everybody can have a hands-on real live test of the system, after which we will decide which modifications may be necessary. We expect this de-bugging process to be finished by the 3rd quarter this year and expect the system to be fully operational by the end of the year.

Q. and during this process what do you expect from Esaote?

Up until now we have had an excellent collaboration with Esaote; their people are not only competent but very cooperative. I am sure this will continue and that the agreed contractual performance specifications will be attained.

But the proof of the pudding is in the eating. Please come back and visit us later in the year when the system is fully up and running and find out the next chapter in this exciting story.

Book reviews

Multi-modality Cardiac Imaging: Processing and Analysis
Ed by P Clarysse, D Friboulet
Pub by Wiley 2015, 370 pp € 130

The imaging of moving organs such as the heart, in particular, is a real challenge because of movement. This book presents current and emerging methods developed for the acquisition of images of moving organs in the five main medical imaging modalities: conventional X-rays, computed tomography, magnetic resonance imaging, nuclear imaging and ultrasound. The availability of dynamic image sequences allows for the qualitative and quantitative assessment of an organ’s dynamics, which is often linked to pathologies.

MRI at a Glance, 3rd Edition
By Catherine Westbrook

MRI at a Glance encapsulates essential MRI physics knowledge. Illustrated in full colour throughout, its concise text explains complex information, to provide the perfect revision aid. It includes topics ranging from magnetism to safety, K space to pulse sequences, and image contrast to artefacts.

This third edition has been fully updated, with revised diagrams and new pedagogy, including 55 key points, tables, scan tips, equations, and learning points.
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Due to the central role of imaging in clinical diagnosis, there has been a growing emphasis on contemporaneous diagnostic radiology interpretations, particularly in the Emergency Department, where such reports may result in decreased length of stay [1, 2]. This trend has resulted in a gradual restructuring of radiology schedules to allow for evening and night coverage, an evolution which has corporate, societal, group, and individual radiology effects [3]. As more radiologists become involved in afterhours work, the community of imagers must become more knowledgeable about the effects of afterhours work and ways to optimize such coverage.

There are three important variables to consider when building or evaluating an afterhours coverage model. First, coverage must be sustainable at the individual and organizational level. Second, radiologists and radiology managers must understand the adverse physiologic and psychosocial impacts of certain coverage models on radiologists. Thirdly, radiologists must be cognizant of maintaining diagnostic quality during periods of afterhours work, which have their own unique challenges. Awareness of these issues would ideally lead to sustainable, high quality afterhours coverage structured in a way that mitigates the health and social impacts to afterhours imagers.

Creating Sustainability in Staffing and Scheduling

In order to provide afterhours coverage, a group or division must first find individuals who are willing and able to work evenings or overnight shifts. Certain individuals have a predisposition to afterhours work – primarily based on an intrinsic flexibility in their sleep-wake cycle and a predisposition to preferring evenings over mornings [4, 5]. This intrinsic preference combined with unique home-life situations causes individual radiologists to self-select for afterhours work, which can lead to longevity and increased workplace satisfaction. Individuals with more than 5 years of prior experience in overnight or afterhours work have made this self-selection, and retaining such employees may result in less staffing turnover [6].

After the correct individuals are chosen, a sustainable afterhours schedule must be assembled; the specifics of this construct will be based on an individual group’s coverage needs. However, experience in radiology staffing and literature from other fields allows us to make general comments on what constitutes a sustainable schedule. Shift schedules can be fixed (i.e. only evening or overnight shifts) or rotating (i.e. a mix of day, evening, and overnight shifts). Fixed schedules have less variables to consider, but sustainable fixed-shift schedules generally lead to a lower total number of clinical shifts worked in a given year. In rotating schedules, attention must be paid to the direction and speed of rotation. Rotating shift schedules should move in the clockwise direction: morning shifts, then evening shifts, and finally overnight shifts. Based on evidence from nursing literature, at the end of a block of overnight shifts, a minimum of 2 days off is needed for recovery [7]. In radiology practices, to avoid cumulative fatigue and turnover, 1-2 days of recovery time should be allocated for each overnight shift following a block of consecutive overnight shifts. Common sustainable fixed shift staffing models currently include 7 days of evening work followed by 7 days off (26 annual weeks off), 5 days of overnight work followed by 9 days off (33.4 annual weeks off), or 7 days of overnight work followed by 14 days off (35 annual weeks off). Regarding overnight shifts, shift start times should be around 9 to 10 PM (and certainly before midnight), and ideal shift end times would allow the radiologist to go home and get in bed prior to sunrise [8]. Overnight shift lengths of 10 hours or less are suggested based on some evidence that errors may increase in shifts that exceed this length [9].

Finally, individual radiologists and radiology managers must understand that dedicated afterhours imagers will be less productive on an annual volume-basis then daytime imagers for two fundamental reasons. First, overnight shifts may or may not be very busy but are nonetheless arduous and secondly, the built in compensation time which offsets the burden of afterhours work will result in a lesser number of productive clinical shifts per year. This is expected. Any pre-existing performance based incentives within a group, division, or department must be adjusted to fit this reality. The
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short term financial bonus or long term career trajectory of an afterhours imager cannot be tied to daytime centric metrics – which will inevitably result in dissatisfaction, frustration, and staffing turnover.

HEALTH AND SOCIAL EFFECTS OF AFTERHOURS WORK

Disturbances of the normal human sleep-wake cycle, and the associated disruption of the circadian rhythm result in physiologic effects of afterhours work [10]. The majority of the human body’s systems are influenced by this fundamental shift, resulting in deleterious short and long term health effects. Short term effects include fatigue, irritability, mood changes, and gastrointestinal effects [3, 5, 11]. Indeed, many overnight workers suffer from gastrointestinal symptoms ranging from variation in bowel habits to gastric and duodenal ulcers [12]. Metabolic syndrome, obesity, diabetes, adverse effects on cardiovascular health, and even increased rates of cancer are longer term impacts of overnight work [3, 5, 11]. The causes of these effects are likely related to both physiologic and hormonal changes resulting from sleep-wake disturbance, as well as from unhealthy lifestyle factors associated with such schedules including sedentary lifestyle and poor diet [13, 14]. Only when employees and employers are cognizant of the significance of these effects can they work effectively to deter them.

Harmful effects of circadian disruption, sleep deprivation, and high-level activation should be balanced by restoration of the circadian rhythm, periods of relaxation-recovery, and excess sleep [15]. Strategies which work to improve day time sleep and improve overall health status can (to some degree) counteract the health effects of overnight work. With regard to daytime sleep – radiologists should work with their families to ensure minimum disruption to daytime sleep. The bedroom should be cold and dark. Light exposure post-overnight shift should have the double the incidence of fatigue-related error or accident compared with nurses who worked static day or evening shifts [17].

The radiologist must be aware of these effects; consider taking longer to review examinations in the final hours of an overnight shift. During an individual shift, fatigue can be mitigated by light exposure, human contact, and ambulation [3]. These actions are particularly important as a radiologist reaches the nadir of the circadian cycle – typically between 4 and 6 AM during a period of overnight work. Taking a short break, walking the hallways in the light, and conversing with other hospital staff can provide all of these fatigue-decreasing stimulations.

CONCLUSION

Afterhours coverage by diagnostic radiologists is a growing mandate, and yet such coverage subjects individual imagers to cumulative adverse physiologic and psychosocial effects. Appropriate schedule, shift, and staffing action can minimize this adversity, ultimately leading to increased satisfaction, decreased staffing turnover, and optimal patient care. It is incumbent upon radiologists and radiology managers to understand these effects and learn about strategies to mitigate the effects of overnight work.

REFERENCES


Image Enhancement and Dose Reduction in Interventional Radiology

In ionizing radiation-based medical imaging, there is a clear correlation between radiation dose and image quality. However while the use of higher levels of radiation leads to improvement in the quality and resolution of the end images, there is increasing concern about the potential danger of such ionizing radiation to patients and clinicians alike. Faced with this challenge, the medical imaging industry and equipment manufacturers have devoted much effort to the development of methods of improving image quality without any increase in radiation risk, — ideally with an actual decrease in such risk.

There is no single, simple solution to this problem, since it involves optimization of all the component steps of the whole medical imaging procedure. Of these, image processing plays a particularly key role. However many of the existing image processing techniques which perform well with individual images present difficulties when filtering rapid image sequences. Typically this leads to blurred anatomical structures and trailing of motion artifacts.

Filters for real-time imaging, for example those applied during fluoroscopy or diagnostic angiography, need faster imaging algorithms than those used during classical post-processing image analysis.

**Image Enhancement Software**

ContextVision’s GOPView iRVultra software enables real-time (30 fps) image enhancement in interventional radiology and represents a new model of image enhancement in the field. The system has the ability in real time to reduce noise and simultaneously preserve or enhance desired image features, such as subtle pathology, vessel edges, stents, catheter tips and guide wires. Since GOPView iRVultra uses an anisotropic...
(directional dependent) adaptive filtering principle, on a pixel-by-pixel basis, there is also no blurring or distortion of key pathology features.

The success of the technology relies on GOP enhancement, which uses an adaptive algorithm that mimics the human visual system to find and identify information and analyze structures, enabling it to distinguish between true and false information (e.g. noise, artifacts). Once it is established that true structures are identified accurately, then filtering and enhancement can be confidently applied to each pixel. This contextual information is then combined with ContextVision's adaptive temporal filtering with advanced motion control, which allows customized enhancement during the various types of interventional procedures.

**DOSE REDUCTION IN REAL TIME**

As a result of improving the overall clinical value by sharpening diagnostically significant images, the GOPView iRV technology is uniquely capable of reducing the radiation dose otherwise necessary to achieve this level of image quality. The system thus allows users to work with lower dose, to enhance the standard image, or a combination of both, ultimately reducing the amount of radiation to which clinicians and patients are exposed.

The implementation of the GOP enhancement software has been optimized for real-time processing, without spatial or temporal blurring, and critical subtle pathology is enhanced with an increase of feature definition and a concurrent reduction in unnecessary noise. So, at lower doses, the increase in noise combined with the reduction in sharpness can be offset by the image enhancement carried out by the GOPView iRVultra software.

**EXPERIMENTAL EVALUATION**

Research carried out at Johns Hopkins University, Baltimore, MD, USA was designed to test this novel, real-time imaging adaptive filter system and to determine its practical efficiency when applied during interventional radiology procedures in a porcine model [1]. The particular goal was the evaluation of the ability of the technology to improve image quality without the need to manipulate radiation dose.

In practice the study involved the placement of a real-time electronic dosimeter for measurements of entrance skin doses. An ionization chamber was used for calibration.

Two separate analyses were carried out: The first was a direct comparison of the quality of the processed versus the unprocessed images (with all other parameters being kept constant). A second comparison was then carried out between processed low dose images and unprocessed high dose images (with all other parameters being kept constant).

**RESULTS FOR UNPROCESSED IMAGE VS. PROCESSED IMAGES**

It was found that the addition of the real-time adaptive filter in all low dose angiograms lead to significant improvements in overall diagnostic acceptability, as well as in visualization of large vessel and spinal structures. [Table 1]. This was achieved without any negative effect on the contrast levels and the visibility of the structures evaluated, and without the introduction of any artifacts.

These results were achieved with a concomitant reduction of 40-50% in radiation dose averaged over all the various studies carried out. In none of the real-time studies carried out did the algorithms used introduce any temporal distortion or blurring of the images.

**REFERENCES:**


**MORE INFORMATION:**

The data above will be presented at ECR 2016 EuroSafe Imaging Poster Exhibition ECR Online & EPOS Lounge (first level), Poster No.: ESI-0047
Radiology evolves with the ecosystem of enterprise imaging

For the better part of the past century, radiology has been a building block of diagnosis. But it has also been a medical discipline apart from all others. Radiologists have been doctors’ doctors, examining patients referred to them and sending reports to those referring physicians. When radiologists conferred, it was usually among themselves.

But value-based medicine is shaking things up. Increasingly images are being transferred not just within radiology but across the healthcare enterprise to and throughout hospitals, clinics, and private physician offices...to oncologists and urologists, orthopedists and general practitioners. This is breeding a culture of collaboration. Radiologists are aspiring to become members of patient care teams. Vendors are developing software to make it easier for them.

Just as radiology is becoming more social, its images are becoming easier-to-interpret, and cloud-based computing is being leveraged for data storage and distribution, as well as to support advanced visualization.

Vendor neutral archives, initially developed more than a decade ago to ease the transition from legacy PACS to more modern incarnations, are paving the way to the consolidation of data across medical disciplines. Vendors are building on these VNAs to develop viewers that spanned multiple media from medical images to PDFs.

Meanwhile, the vendors of information technology systems – the PACS and electronic medical records systems – are capitalizing on the opportunities this changing mindset creates. With the increasing consolidation of data, collaboration and integrated workflow, they are deconstructing PACS into its components, promoting the interoperability of best-of-breed solutions that integrate patient images and elements of the electronic medical record, as they channel radiology workflow into the mainstream. In this way, they hope to promote increased efficiency and decrease cost.

EMPPOWERING THE ENTERPRISE.

Providing images across the enterprise is the grease that could make healthcare operate more smoothly and efficiently, say advocates of an image-empowered enterprise. This will promote collaboration among specialists, as it reduces costs, they say.

Siemens’ syngo.plaza boosts productivity by making images available across departments and devices, accelerating interpretation and streamlining workflow. According to the company, its latest user interface is more intuitive and optimizes reading and reporting. It automates 3D workflow through automatic landmarking and by parsing anatomy. Siemens has focused syngo.plaza on routine 2D and 3D reading, including maximum intensity projections and multiplanar reconstructions.

Mach7 Technologies looks at enterprise imaging (EI) as an “ecosystem” in which different species of technologies plug into its EI platform. These technologies may be worklist or reporting solutions or diagnostic viewers. The vendor that provides them doesn’t matter, says company Chief Technology officer Eric Rice.

“Our customers really pick the applications that solve their needs – ones that provide the best clinical capabilities – so the doctors can provide the best patient care,” says Rice who notes that customers sometimes pick clinical applications from Mach7 and sometimes from other vendors. “I have yet to find a single PACS or viewer or portal or sharing or reporting solution that fulfills the needs of all specialties across all departments within the facility,” he says. “Our platform stabilizes the archiving and communication of the data so you can plug in those best-of-breed clinical...
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Knowing what responsibility means
applications that provide the best value to the enterprise.”

**Sectra** promotes collaboration among members of multi-specialty oncology boards through its Enterprise Image Management system, enabling the patient care team with medical images when those images are needed, says Frederik Gustavsson, Sectra chief technology officer. Team members can use the system to retrieve and process images to help them develop and implement a patient management plan. Sectra does this by supporting images in pathology, as well as radiology as part of a consolidated patient record.

“This allows us to support complex care pathways across oncology in a very efficient manner,” Gustavsson says. “With just one click, you can pull up all the different images that were gathered around this pathway, including everything from ultrasound images to mammograms to microscopic images of the biopsy and specimen X rays.”

Providing histopathology images along with radiological ones “really makes Sectra unique,” he says. “This is really providing a rich powerful toolset to improve healthcare for users and ultimately patients.”

**Philips Healthcare** brings radiologists and oncologists together with specialized tools. The Measurement Assistant helps the radiologist create an inventory of patient measurements, which are then “curated in a very consumable way for the oncologist in the form of the Oncology Dashboard,” says Mark Khalil, Philips’ global director of solutions marketing and strategy. “This is the beginning of a collaborative sharing of results between the radiologist and the oncologist with the oncologist able to complement the results with additional relevant information around the treatment of the patient.”

Catalyzing this collaboration between radiologists and oncologists, these tools drive workflow. Trends over time, as in the case of images that demonstrate changes in specific lesions, become apparent in the context of a timeline that shows events, for example, when medication began and ended.

**CONSOLIDATING DATA WITH VNAs.**

Vendor neutral archives were first proposed as a hedge against the obsolescence of PACS, promising a means by which new generations of PACS technology could be transitioned into everyday use.

Although decidedly oriented toward imaging and radiology, VNAs today can be structured to archive and manage many types of files, including AVI videos from endoscopy, TIF images from ophthalmology, JPEGs from wound care, and PDFs from radiation oncology.

**Siemens’** syngo is a multimedia VNA, capable of tying together multiple modalities, several PACS – including Siemens’ own, syngo.plaza – and non-DICOM data. “With syngo.share, we have a VNA that acts as a multimedia archive and covers a multitude of document types,” says Arthur Kaindl, CEO of Siemens’ syngo business unit. “It enables not only the storing of image and data but the exchange and sharing of data within an enterprise.”

This wide-ranging support for different types of data promotes collaboration among the specialties that generate these data. Siemens’ teamplay links hospitals and experts, supporting the exchange of data and opinions among members interacting through tablets, laptops and desktop PCs in the cloud.

Teamplay promotes collaboration, bringing healthcare professionals and patients together along with clinical data in a way that accelerates decision-making, Kaindl says. “We are bringing together their global expertise, their knowledge, in order to help radiologists, our customers, to face and to solve local challenges that they are seeing day-to-day,” he says. “It may be optimizing the dose exposure for their patients or it may be optimizing the clinical and operational workflows by looking into better utilization of the imaging equipment.”

Communication is enhanced by universal viewers, such as **Calgary Scientific’s** ResolutionMD, which displays patient images and reports on computers, as well as mobile devices, such as smartphones. This enterprise-wide viewer can work with any archive or workflow engine, according to Jonathan Draper, director of healthcare product management at Calgary Scientific.

“It provides a flexible solution that can answer the needs of a broad number of clinical users,” he says. “It fits into whatever the workflow may be, regardless of what device is being used or where (it is being used).”

Similarly, **Carestream Health’s Vue Motion** is a zero-footprint vendor neutral viewer, which can be implemented independently or with other Carestream products. Compatible with certain tablets and smart phones, including ones from Apple and Samsung, Vue Motion leverages a web browser to display images, or can be embedded into an EMR to show information in the electronic medical record.

**TeraRecon** offers an image viewer that, utilizing other TeraRecon technologies, can connect to disparate data sources. The company describes this viewer as being part of a “truly universal and ubiquitous viewing platform,” one that can support images made with visible light, as well as handle “some of the most advanced use cases. It can move to various viewing platforms and back and work equally well inside and outside of the EMR.”

**GE’s** Centricity Solutions for Enterprise Imaging is a broad-based imaging suite designed to help customer manage image archiving, collaboration, visualization and workflow. “As part of this we are moving Centricity Enterprise applications into the GE Health Cloud,” says Justin Steinman, chief marketing officer for GE Healthcare IT.

GE uses its newly minted Health Cloud to power collaboration tools onboard its Radiology, Cardiology and Pathology Imaging portfolio. These tools not only support collaboration among physicians, but include embedded predictive analytics. The GE Health Cloud will serve as a platform for running healthcare applications as a service in the cloud, Steinman says.

Like any platform, it is useless without applications. For that reason, GE is putting together an app store, like ones run by Apple and Google. “We want 80% of the applications to come from independent software vendors, whether they are two guys in a garage, a major academic medical center or an industry scientist developing algorithms,” Steinman says.

Case Exchange is among the first such applications. Its cloud-based deployment minimizes the need for on-site infrastructure as its pay-as-you-go pricing eliminates the need for capital expense. GE is planning to launch GE Health Cloud in the UK and France later in 2016, with more countries to follow in 2017.

Siemens’ teamplay helps providers address challenges such as dose optimization. Image courtesy Siemens Healthcare.
But, efficiently managing clinical data from many medical disciplines requires more than technology, according to McKesson Health IT exec Jordan Lister. “It is really about the transformation, the adoption and the utilization of technology to realize the benefit of capital expenditure,” says Lister, the company’s director of global business development. This demands a synergy between people and technology, he says.

The combination of McKesson technology and staff expertise can create for customers a single view of patient imaging data across the enterprise. McKesson consolidates task lists, as well as multiple PACS, grouping tasks and prioritizing them to promote efficient utilization of resources across enterprise, according to Lister.

“We bring domain expertise to solve some of the very complex problems our customers face in workflow and interoperability,” he says, “and to align the business objectives of the C suite to really build a strategic plan.”

GOING BEYOND DATA STORAGE.

In the gray area between IT and modality are advanced visualization technologies that span the healthcare enterprise. These are exemplified by Philips Healthcare’s Magic Glass, a viewing tool built into the company’s Intellispace system. Philips recently extended this tool to support spectral CT, whereby data acquired from the signals of different-energy X rays can be reformatted to indicate chemical composition. With Magic Glass, for example, radiologists can choose a region of interest within a CT image displayed on the company’s PACS and, with a single click, open a window in which after several seconds a spectral CT image appears.

“Magic Glass maintains the clinical context, launching directly to the slice being reviewed,” says Sondra Miller, Philips head of global CT marketing. “It is very easy to use; requires no training; and truly brings spectral CT to people who have limited experience with it.”

GE’s ViosWorks uses the GE Health Cloud not for the archival of clinical data (as the company’s enterprise imaging portfolio does), but in place of a supercomputer to process data coming from cardiac MR. The company’s Cloud makes processed images available to multiple users across the enterprise. “We believe ViosWorks can bring cardiovascular applications into the (MRI) mainstream,” says Ioannis Panagiotelis, GE’s chief marketing officer for global MR.

Panagiotelis notes that today fewer than 1% of all MRI applications are focused on the heart. One reason is the long processing time – up to an hour – that cardiac MR cases typically require, he says. Another is the need for a highly skilled technologist, who must interact with the scanner to obtain tailored acquisitions, for example, two- and four-chamber views of the heart, which must be obtained during carefully timed patient breath holds. By contrast, ViosWorks is “very, very simple,” Panagiotelis says.

A specially trained technologist is not needed. Instead, the operator indicates a slab acquisition of the chest. The scanner does the rest, acquiring isotropic data as the patient breathes freely. (The protocol runs on either a 1.5T or 3T scanner, according to GE.) Data are reconstructed in less than ten minutes into dynamic images of the heart and can be transmitted anywhere in the world.

Processing time may be only a sixth of what would otherwise be needed to reconstruct a cardiac MR scan, Panagiotelis says, but, ironically, the quantity of data processed by ViosWorks is 100 times greater – 20 GB versus 200 MB. Without the GE Health Cloud, he says, “you would need a supercomputer to process the data and (this computer) would cost $1 million. Nobody would buy it.”

CHANGING MINDSETS.

Thinking creatively about how the cloud and other technologies can be repurposed may be needed, if radiology is to be truly integrated into enterprise healthcare. To make the radiologist part of the team, Cerner advocates the adoption by radiology of an EMR-driven workflow. Brandon Long, Cerner director of radiology and clinical imaging, says “PACS- and RIS-driven information models are relics of radiology’s past.”

“The electronic medical record is the workflow engine for the care team,” Long says. “The radiologist is one of the last to be in the EMR.”

Long says Cerner’s EMR gives radiologists contextual information about the patient – it gives them, he says, “what they need to help the care team take action.”

Through the Cerner EMR, radiologists can review a patient’s medical record and prior diagnostic procedures; see prior images in a PACS viewer; and communicate with the ordering physician, sending notes and comments about the appropriateness of an ordered exam, for example, or results from exams that have been done.

Mach7’s Chief Technology Officer Eric Rice says the biggest challenge facing enterprise imaging is making workflow and data communication efficient.

Meeting these challenges may be critically important if radiology is to achieve a greater role on the patient care team.
Pre-hospital stroke care: from portable CTs to mobile thrombolysis

A blocked artery in the brain can often lead to irreversible brain injury resulting in an ischemic stroke with major disability, dementia or death [1, 2]. The treatment of such strokes involves the administration of intravenous tissue plasminogen activator (IV tPA) within 4.5 hours of symptom onset to restore blood flow and tissue perfusion [3]. Several clinical and radiological factors must be considered prior to administering tPA, including obtaining a head computed tomography (CT) scan to exclude intracranial hemorrhage.

Despite the potential for tPA to improve outcomes of patients with ischemic strokes, only a limited number of patients arrive at the hospital in time to be eligible for this treatment [4,5]. While reasons for this discrepancy are complex, a major limitation is the current system of triaging stroke patients in the emergency room.

Unfortunately, despite efforts to streamline systems of care in emergency departments, the median door to needle time in stroke center emergency rooms in the United States approximates 60 minutes [6], with most patients being treated beyond 2 hours [7]. Given the direct relationship of improved treatment successes with faster treatment times with IV tPA [8-10], minimizing delays in the triage, evaluation and treatment of patients is vital.

Optimizing pre-hospital management of stroke patients by using specially equipped ambulances, so-called Mobile Stroke Units (MSU), is one way to speed treatment with tPA so that it can be administered within the first 60 minutes after symptom onset when it is likely to have its greatest impact.

Following the successes of establishing and operating the first MSUs in Germany [11-12], the earlier treatment of ischemic strokes became tangible in the United States with the launch of the first MSU in Houston, Texas, in May 2014. The MSU team is comprised of a vascular neurologist (VN), a nurse skilled in stroke management, a paramedic, a CT technologist, and a remote VN via teledmedicine (TM).

The MSU itself is a Houston Fire Department ambulance that is fitted with a portable CT scanner and contains all necessary equipment needed for the acute evaluation and treatment of a stroke patient.

The portable CT scanner (CereTom, Samsung Neurologica Corporation) is itself installed across the entire back wall of the MSU, with special brackets to lock the CT scanner in place during transport. Additional enhancements were made to the power and charging circuitry, including an upgrade to the standard on-board generator to provide additional power for operating the CT scanner.

Patients eligible for tPA are positioned on a gurney which is then raised to align the patient’s head with the scanner when performing the CT scan. A standard 8 slice, 5mm configuration is obtained for each patient and is available for immediate viewing on a portable laptop by the onsite VN. A DICOM sharing grid is used to directly push images from the MSU to the remote VN and destination hospital [13]. Direct comparison of CereTom images with those from a standard clinical CT scan have shown a high comparability of CereTom images in terms of diagnostic accuracy and reliability versus a standard clinical CT scanner [14].

THE BEST-MSU STUDY

We have initiated a study on the Benefits of Stroke Treatment delivered using a Mobile Stroke Unit compared to standard management (BEST-MSU) [15]. Now in its second year of patient recruitment, the study not only aims to address whether an MSU model of delivering stroke care can speed the treatment of ischemic stroke patients with IV tPA, but if this can also be accomplished using TeleMedicine (TM) and result in being more cost-effective compared to current standard treatment by emergency medical providers.

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“... It typically takes roughly an hour for a stroke patient to be evaluated and treated in the emergency room (ER). So if we can actually put the ER in the ambulance and take the CT scanner to the patient, we could treat the patient at the scene with the medication and save that hour ...”

Dr J Grotta
Of the twelve patients treated with tPA on the MSU, four (33%) were treated between 0 and 60 minutes of symptom onset, four between 61 and 80 minutes from onset, and four between 81 and 270 minutes of onset. The average time from emergency activation to tPA administration in the MSU was 47 minutes (range 37 – 60 minutes), with an average on-scene time from MSU arrival to tPA bolus of 25 minutes (range 17 - 42 minutes). Four of the 12 MSU tPA patients had endovascular treatment for large artery occlusions, with an average symptom onset to groin puncture time of 175 minutes (range 140 - 224 minutes). Four of the 12 MSU patients treated with tPA had mild or no symptoms without disability at 90 days, with 3 patients being near their baseline level of function. There were no TM malfunctions, and 90% agreement (i.e. 8 out of 9 patients) between the remote and on-site VN for tPA eligibility.

SAFETY CONSIDERATIONS
The primary safety concern in operating the CT scanner on the MSU is the amount of radiation exposure. Based on one year of operation (CT scans for 106 patients), we have found that the general public's cumulative deep dose equivalent radiation exposure is less than 0.02 mSv hr⁻¹ (2 mrem hr⁻¹) or 1.0 mSv (100 mrem) (the annual general public dose limit for the effective dose is 1 mSv), while being 1.14 mSv (114 mrem) for the CT operator on the MSU, which is well below ten percent of the current United States occupational dose limit. It was also reported that radiation levels were found to be within normal limits in the CT scanners utilized in the MSUs in Germany, despite the design of those MSUs being different than the MSU utilized in Houston [17]. There were no technical malfunctions of the CT scanner or the MSU ambulance, nor any hemorrhagic or other clinical complications [15].

RESULTS
During the 10 week run-in phase, the MSU was dispatched on 130 occasions (2.7 times/day) and was called off en-route to the scene on 41 of these calls after the first responders deemed the patients as ineligible for the study. Twenty-four patients met criteria for enrolment during the 57 MSU days (8 weeks), and 2 during the 14 SM days (2 weeks). During the MSU days, 13 of the 24 patients were deemed tPA-eligible; 12 were treated with tPA on the MSU, and one was not treated until arrival in the emergency department (ED). On the SM days, one of the 2two patients was deemed tPA-eligible and received tPA in the ED. Four of the 26 enrolled patients were found to have primary intracerebral hemorrhages (ICH) after CT scanning on the MSU, all of whom had their blood pressure treated on board as per current management guidelines [16]. One had an acute subdural hemorrhage, while three had seizures on board the MSU, which were thought to be the cause of their presentation. Two patients had complete resolution of symptoms before tPA was started and one patient was deemed ineligible for tPA due to uncertainty about the time of symptom onset.

DISCUSSION
The BEST-MSU study has provided us with valuable insights into the aspects of pre-hospital stroke care that need to be prioritized in order to efficiently triage and treat stroke patients. There were about 1.5 treatments per week during the run-in phase, with 33% being treated within the first hour, so our average “door-to-needle” time was 25 minutes on the MSU (where all diagnostic equipment, medications, and skilled treatment team are located in one dedicated space and immediately available). This is comparable to the fastest reported ED “door-to-needle” times [18]. Not only has this confirmed our hypothesis that large numbers of stroke patients can be treated on the MSU with potentially faster initiation of treatment, but we have also been reassured that remote TM assessment is possible, similar to other single center studies that are utilizing TM on MSUs [19]. Although we have a high TM agreement rate regarding tPA eligibility with that of a live VN assessment (90%), the question of whether telemedicine is a reliable way to replace the on-site vascular neurologist needs further study [20].
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The MSU has also been useful in the rapid management of patients with ICH. Since hemorrhage enlargement occurs more frequently early in the course of ICH [21-22], the MSU provides an avenue to promptly administer intravenous antihypertensive medications to reduce blood pressure and/or other hemostatic agents in order to reverse certain coagulopathies that are associated with ICHs.

Given recent evidence from clinical trials showing the efficacy of endovascular therapies (ET) for large vessel strokes [23-24], it is also vital for triage processes in acute stroke care to be modified in a manner that promotes efficient transitions from the pre-hospital setting to stroke centers with ET capability in order to minimize treatment delays.

The identification of patients with large vessel occlusions using CT angiography on the MSU can thus potentially save time by bypassing initial transport to non-endovascular facilities, by expediting the TPA administration and laboratory testing required prior to ET, and by early warning of the endovascular team allowing timely mobilization. Testing the reliability, feasibility and accuracy of CT angiogram on the MSU is planned for this year 2016.

CONCLUSION

We have thus far enrolled 289 total patients into the BEST-MSU study. We are also collaborating with other stroke centers in the United States to explore the generalizability of this model of stroke care in different cities with different dynamics of pre-hospital emergency medical systems. On a worldwide scale, MSUs hold great promise with the potential to improve patient outcomes and provide more cost effective medical care.
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Current Status of Knowledge Regarding Accumulation and Toxicity of Gadolinium-Based Contrast Agents in the Brain

Gadolinium-based contrast agents (GBCAs) have been in use for almost 30 years and their safety profiles are excellent with a low incidence of adverse events. The most recognized gadolinium-related toxicity is nephrogenic systemic fibrosis, which in practice has virtually disappeared since 2009, thanks to the introduction of a simple renal function screen. However recent data regarding neural tissue deposition of gadolinium in patients with normal renal function have shaken confidence in the agents and resulted in a discussion of potential safety issues which is all the more relevant given the exponential increase in the usage of GBCAs in clinical practice. In this article, we review the main properties of GBCAs along with the available clinical evidence regarding their side effects and toxicity. A short review of recent publications describing neural tissue deposition of gadolinium in patients with normal renal function is also presented.

WHAT ARE GBCAs?

Gadolinium is a heavy metal in the lanthanide series that is used in MRI because of its paramagnetic properties. Free gadolinium is toxic in humans so for it to be used “in vivo” it must be chelated to organic ligands. The toxicity of free gadolinium in humans is mainly because its ionic radius is close to that of calcium and thus it becomes a potent blocker of many types of voltage-gated calcium channels and inhibits calcium-activated enzymes at nanomolar and micromolar concentrations [2].

Based on the structure of the ligand employed and its stability in vivo, as measured in human serum stability studies, GBCAs can be classified in three groups: nonionic linear, ionic linear, and macrocyclic. Macrocyclic chelates are more stable than nonionic linear chelates and ionic linear chelates are more stable than nonionic linear chelates [3]. The risk of dissociation of the gadolinium ion (Gd³⁺) is higher with linear than with macrocyclic chelates and with non-ionic than with ionic chelates.

The dechelation of gadolinium from its ligand is an equilibrium process mainly defined by kinetic and thermodynamic stabilities. Thermodynamic stability is the thermodynamic equilibrium in a solution between the dissociated gadolinium ion, the ligand and the entire contrast molecule, whereas the kinetic stability is the speed at which the dissociation equilibrium is reached. Thus, if kinetic stability is high, the speed of dissociation is low and vice versa [4]. Kinetic stability is evaluated using the dissociation half-life time (T_{1/2}) of GBCAs in various conditions. Other factors, including the concentration of competing ions or ligands and the interaction times between the gadolinium chelates and their competitors (increased in patients with renal insufficiency) contribute to the stability of GBCAs.
Contrast media

Today, more than 300 million doses of GBCAs have been administered worldwide [4,5]. The administration of GBCAs is rarely associated with adverse effects. In the past GBCAs were considered extremely safe with an incidence of allergic-like reactions ranging from 0.004% to 0.7% [6] and severe life-threatening anaphylactic reactions ranging from 0.001% to 0.01% [6-9]. The manifestations of allergic-like reactions to GBCAs are similar to those of allergic-like reactions to iodinated contrast media. All GBCAs have comparable and extremely low incidences of severe anaphylactic reactions. Severe anaphylactic reactions resulting in death are extremely rare and have been reported in approximately 1 in 300,000 administrations of GBCAs with 40 deaths per 51 million administered GBCA-doses between 2004 and 2009 (10,11). These rates are about one-third of those reported for nonionic iodine-based contrast media.

All GBCAs have comparable and extremely low incidences of severe anaphylactic reactions. Severe anaphylactic reactions resulting in death are extremely rare and have been reported in approximately 1 in 300,000 administrations of GBCAs with 40 deaths per 51 million administered GBCA-doses between 2004 and 2009 (10,11). These rates are about one-third of those reported for nonionic iodine-based contrast agents.

SAFETY PROFILE OF GBCAs

SAFETY PROFILE OF GBCAs

Until now, the only well-established clinical entity related to toxic effects of gadolinium was nephrogenic systemic fibrosis (NSF). NSF was first recognized in 1997 in 15 dialyzed patients and fully described 3 years later by Cowper et al. (12). Its association with GBCAs administration was established 5 years later (13,14). NSF is a devastating and potentially life-threatening disease characterized by widespread progressive tissue fibrosis typically occurring in patients with severe or end-stage chronic kidney disease or those with severe acute kidney injury [15,16] after administration of less stable GBCAs. Limiting the use of GBCAs in patients with renal impairment, and switching from the less stable GBCAs to the more stable ones [17] has greatly reduced the incidence of NSF with no new cases reported since 2009. Recent investigations have shown that there is no association of gadobenate dimeglumine (MultiHance) or gadobuterol (Gadovist) with NSF even in patients with abnormal eGFR undergoing peritoneal dialysis, hemodialysis, or no dialysis [18,19]. The extremely safe profile of the most stable GBCAs led many to believe that they did not cause any disease when the appropriate dose was administered, especially in patients with normal renal function.

Since 2004, we have recognized that in vivo exposure to gadolinium chelates results in its long-term incorporation into bone matrix [20-22] in patients with normal renal function. More recently, several studies have demonstrated gadolinium deposition in neural structures [23-25]. Despite no obvious gadolinium-mediated micro- [23] or macroscopic changes [24], areas of gadolinium deposition are found in the brain and the long-term effects of this retained gadolinium are unknown.

IN VIVO NEURAL TISSUE GADOLINIUM DEPOSITION

TABLE 1. Gadolinium-based contrast agents (GBCAs) - biochemical properties. Ktherm, thermodynamic stability constant; Kcond, indicates conditional stability constant at physiological pH. T 1/2, dissociation half time at pH 1.0 and 25ºC.

<table>
<thead>
<tr>
<th>Chemical Structure</th>
<th>Trade Name</th>
<th>Log Ktherm</th>
<th>Log Kcond (at pH 7.4)</th>
<th>T 1/2</th>
<th>Elimination</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LINEAR</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gd-DTPA</td>
<td>Omiscan®</td>
<td>16.9</td>
<td>14.9</td>
<td>&lt;5s</td>
<td>Renal</td>
</tr>
<tr>
<td></td>
<td>OptMARK®</td>
<td>16.6</td>
<td>15.0</td>
<td>&lt;5s</td>
<td>Renal</td>
</tr>
<tr>
<td><strong>IONIC</strong></td>
<td></td>
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</tr>
<tr>
<td>Gd-DTPA</td>
<td>Magnevist®</td>
<td>22.1</td>
<td>17.7</td>
<td>&lt;5s</td>
<td>Renal</td>
</tr>
<tr>
<td>Gd-BOPTA</td>
<td>Multihance®</td>
<td>22.6</td>
<td>18.4</td>
<td>&lt;5s</td>
<td>95% Renal</td>
</tr>
<tr>
<td>Gd-EOB-DTPA</td>
<td>Evist®/Primovist®</td>
<td>23.5</td>
<td>18.7</td>
<td>&lt;5s</td>
<td>59% Renal</td>
</tr>
<tr>
<td>Gd-DSB-DTPA</td>
<td>Abilavir®</td>
<td>22.1</td>
<td>18.9</td>
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<td>Gd-DO3A</td>
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<td>Gd-DTPAC</td>
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<td>Gd-DTPAC</td>
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gadodiamide (Omniscan) [26-31] but it has also been shown with gadopentetate dimeglumine (Magnevist) [26,30]. Conversely, the more stable macrocyclic GBCAs, such as gadoteridol (ProHance) [30], gadoterate meglumine (Dotarem) [31,32], and gadobutrol (Gadovist) are not associated with MRI changes [33,34]. Gadobenate dimeglumine (MultiHance), an agent of intermediate stability, is associated with fewer MRI changes compared to the linear gadodiamide (Omniscan) [29] and gadopentetate dimeglumine (Magnevist) [35] but more when compared to the macrocyclic gadoterate meglumine (Dotarem) [35]. However, lack of signal changes does not seem to exclude neural tissue deposition. In fact, recently Murata et al. [25] studied autopsy samples from 9 decedents who had received gadoteridol (ProHance), gadobutrol (Gadovist), gadobenate (MultiHance), or gadoxetate (Eovist) and their preliminary results showed deposits of gadolinium in all brain areas sampled with the highest levels being in the globus pallidus and the dentate nucleus.

Recent animal studies demonstrated that repeated administrations of gadodiamide (Omniscan), gadobenate dimeglumine (MultiHance), and gadopentetate dimeglumine (Magnevist) in healthy rats was associated with progressive and significant T1 signal hyperintensity in the dentate nuclei with concomitant gadolinium deposition in the cerebellum. Repeated administrations of macrocyclic GBCAs (gadoterate meglumine, Dotarem) did not reveal these effects [31,36].

It is not known if the deposited gadolinium in brain remains bound to the chelate or if it is bound to phosphate and calcium; binding to calcium has been reported in the skin of NSF patients. It seems likely that gadolinium ions are free from the chelate, as the less stable agents are associated with this abnormal T1 signal hyperintensity while the more stable macrocyclic agents are not [37].

**GADOLINIUM TOXICITY**

The clinical significance of these MRI brain changes is unknown. No specific clinical symptoms related with MRI brain signal changes have as yet been established. Recognizing this observation, the FDA drug safety communications statement expresses that no adverse health effects have been identified with repeated use of GBCAs for MRI [38,39]. The European Medicine Agency [40] the American College of Radiology [6], and the European Society of Urogenital Radiology [41] have not yet proposed guidelines concerning gadolinium deposition [42]. Gadolinium is deposited in the capillary endothelium and in the neural interstitium [23] which may explain the lack of symptoms [37]. On the other hand, symptoms after gadolinium may occur but may be overshadowed by those of the disease for which patients are being evaluated [37]. Our current work is investigating patients with normal renal function who describe clinical symptoms, including a foggy mentation, following GBCA administration [43].

**CONCLUSIONS**

Gadolinium accumulation in brain varies depending on the type of chelate used. A risk of deposition is present in any MRI examination performed with at least the less stable GBCAs. Based on our current knowledge, the National Institutes of Health suggest that: (1) GBCAs should be used only when clinically indicated or when specified in an institutional review board approved protocol; (2) whenever possible the use of a macrocyclic GBCA should be considered rather than linear agents; (3) for patients with documented sensitivity to macrocyclic agents, linear agents are appropriate if clinically indicated; [4] FDA label indications and dosing recommendations should be carefully followed, and [5] research programs to evaluate patients who have received multiple doses of GBCAs should be encouraged [38].

It is not clear at present whether neurotoxic effects of gadolinium deposition occur, although none have so far been definitively shown. One must consider at present the potential unknown risks of residual gadolinium in our decisions regarding the administration of GBCAs and make efforts to minimize any residual gadolinium in a patient's body [41]. It may be particularly important to use the most stable available GBCAs to mitigate against these risks. The increasing number of MRI scanners and the large number of patients undergoing contrast enhanced studies may result in additional risks for gadolinium accumulation with potential health consequences.

**REFERENCES**

A center for fetal care with a high reputation

Imperial College is the only university in the UK to focus exclusively on science, medicine, engineering and business. The Faculty of Medicine is renowned for its teaching, patient care and research activities with the Centre for Fetal Care in Queen Charlotte’s and Chelsea Hospital being particularly active. The centre has recently acquired a new ultrasound system for prenatal imaging.

We wanted to find out more about the clinic in general and the equipment in particular so we spoke to Dr C Lees, Reader in Obstetrics and Fetal Medicine.

Q. Please tell us about your hospital. Where do your patients come from and which geographical area do you serve.

The Centre of which I am head — the Centre for Fetal Care or CFC — is located in the Queen Charlotte’s and Chelsea Hospital (QCCH), a constituent hospital of the Imperial Healthcare NHS Trust and with university affiliations with Imperial College London. The Imperial Health-care NHS trust is responsible for three major hospitals in London, namely St Mary's, Hammersmith and Charing Cross hospitals. QCCH basically serves the North West London area.

As for our obstetrics services, Imperial has a total of 9000 deliveries per year, out of which 5000 deliveries take place at Queen’s Charlotte’s hospital

Q. Now let’s turn to the Center for Fetal Care.

Our fetal medicine service is based in the Centre for Fetal Care (CFC), a tertiary specialist referral day case unit that looks after pregnant patients who may have had previous medical problems in a past pregnancy, have had testing to suggest possible complications in their current pregnancy or have a family history of various medical complications.

The Centre for Fetal Care is one of a handful of units in the UK performing laser treatment in cases of twin-to-twin transfusion syndrome.

While we serve our local booking population, we maintain fetal and maternal medicine services that have a national reputation.

The fetal medicine service performs about 4000 scans each year and we are a centre for advanced diagnostic, invasive and therapeutic procedures. QCCH is linked to the Royal Brompton Hospital in London for fetal and paediatric cardiology, Kennedy Galton laboratories for genetics and the Chelsea and Westminster Hospital for paediatric surgery

Q. What personnel and equipment do you have to provide the service expected of you? How many examinations do you carry out per year?

The Centre for Fetal Care has six consultant staff or senior specialists, two subspecialty fellows in the UK’s Royal College of Obstetrics and Gynaecology Maternal and Fetal Medicine
(RCOG MFM) training scheme and six research and visiting fellows. There are two full time specialist midwives, a genetic counsellor and for specific weekly clinics a pediatric urologist, neurosurgeon, pediatric surgeon, clinical genetecist, pediatric neurologist and neonatologists. This is in addition to daily fetal echocardiology sessions.

Q. You have recently acquired a Samsung WS 80 Elite ultrasound system with Crystal Vue. What were the reasons for your choice? Since when has it been up and running? What do you think of its performance?

The system was price competitive and offered new imaging packages. In general, the WS80 is an excellent machine for anomaly and later pregnancy scans. We have been working with Samsung engineers and apps specialists to optimize all the settings and to determine what the machine is really capable of. But Book Book Review the 2D detail level is excellent beyond 20 weeks, and at least equivalent to its peers in the first trimester. The systems are in use for 'low risk' screening scans, and also in CFC for the more complex patients that require highly specialist imaging.

We are developing facial and CNS imaging and Crystal Vue was of particular interest to us. We have been able to image the hard palate better than using conventional 3D imaging and reverse face views, and the brain imaging is allowing us to see the sulci and gyri in a way that was previously not possible through conventional 3D techniques. However the learning curve is steep and we are not quite there yet.

Q. What about your studies using the system on imaging of fetal spine and ribs? Other applications?

We have started to image long bones, joints and skeletal dysplasias with Crystal Vue. We are able to assess bone contours, shape and size in a way we have not been able to previously and the imaging of the spine and ribs is without equal.

Q. So what about the future?

Over the next six months we aim to compare CNS, facial and limb imaging with Crystal Vue to conventional 2D, 3D and MRI imaging. In doing so, we will build up a library of Crystal Vue images as an “atlas”, and also — this is very important — a “step-by-step” guide for those starting out to use this technology which we think holds considerable promise.


Book review

Echocardiography in Pediatric and Congenital Heart Disease: From Fetus to Adult, 2nd Edition
By Wyman W. Lai, Luc L. Mertens, Meryl S. Cohen & Tal Geva
Pub By Wiley-Blackwell, 928 pp., Feb 2016, €263

This comprehensive textbook on the echocardiographic assessment of pediatric and congenital heart disease has been updated for a second edition with an emphasis on new technologies. This highly-illustrated full-color reference contains over 1200 figures, and offers over 600 video clips on a companion website. The 2nd edition is fully updated, with new chapters on the assessment of the post-Fontan procedure patient and on pregnancy and heart disease. The revision emphasizes new technologies and quality of images.

Each lesion chapter includes new section highlighting the key elements of the echocardiogram(s). The book is written by experts from the leading centers around the world, with numerous new authors. Comprehensive content contains overview of ultrasound physics, discussion of laboratory set-up, protocol for a standard pediatric echocardiogram and quantitative methods of echocardiographic evaluation, including assessment of diastolic function.
The impact of Pocket Ultrasound Devices on physical examinations

The recent development of miniaturized ultrasound systems has resulted in the improvement of the diagnostic accuracy of physical examinations and increased the appropriateness of further testing. This article summarizes the advantages of Pocket Ultrasound Devices (PUDs) and describes the results of a study designed to evaluate the effect of their use in the examination of patients with suspected common abdominal conditions.

Over the last 20 years, the increasing availability of fully functional, compact ultrasound equipment has allowed ultrasound (US) to be carried out at Point-of-Care sites, such as at the patient bedside [1]. Modern miniaturized ultrasound systems are now the size of a smartphone, so can fit in a clinician’s pocket and provide real-time dynamic images, thus enabling physicians to visually inspect a patient’s internal anatomy while carrying out a physical examination. Direct correlations of the US findings can be made with the patient’s clinical history and symptoms. Classically, physical examinations are based on inspection, palpation, percussion and auscultation. For a long time the stethoscope was the only device which could improve the performance of such exams.

However the accuracy of classic semiotics is poor, with low reproducibility, sensitivity and specificity [2]. PUDs are increasingly being seen as a tool with the potential to improve the performance of bedside diagnoses.

For example, in the field of cardiology, the results obtained by PUDs have been considered to be comparable to those obtained with standard equipment and therefore suitable for widespread use[3, 4]. Students carrying out examinations using PUDs have been shown to be more accurate in making certain diagnoses of heart diseases than expert cardiologists using physical examination alone [5]. More recently, the accuracy and reproducibility of a PUD examination have been confirmed in the detection of ascites and focal liver lesions, which are the leading indications for abdominal US.

Thanks to constant technological improvement there is substantial equivalence of images with those from conventional ultrasound devices, so it is not surprising that the values of PUD accuracy are similar to those of conventional systems.

However the downstream effects of the use of PUD-assisted examination on clinical endpoints still need to be described.

A recent pragmatic randomized clinical trial carried out in patients with suspected nephrolithiasis, found that a differential diagnostic tree based on the use of PUD showed no differences with those established by radiology US and CT in terms of 30 days incidence disease complications [6].

Other questions still to be answered are how — and for how long — a clinician with no previous experience in ultrasound needs to be trained in order to reach an acceptable level of confidence and expertise, and which clinical diagnostic hypotheses can be tested with these devices.

COHORT STUDY

To address such issues we recently carried out a cohort study [7] involving four hospital medical wards, one gastroenterology outpatient clinic, and 90 general practices in the same geographical area (Lombardy, Italy). After a short standardized training course, one hundred and...
thirty five physicians used PUD to examine 1962 consecutive patients with one of 10 suspected diagnoses, namely ascites, pleural effusion, pericardial effusion, urinary retention, urinary stones, gallstones, biliary-duct dilation, splenomegaly, abdominal mass and abdominal aortic aneurysm. These are common diagnostic questions in both in- and out-patient settings and are generally poorly answered by physical examination alone. They may therefore benefit from the addition of a focused PUD examination.

In the study, each physician decided whether the PUD results were enough to confirm or exclude the diagnostic hypothesis, whether the PUD results were enough to answer the introduction of PUD on clinical decision making and whether overconfidence in the diagnosis decided by the physicians. As expected there was a wide variation of indications for PUD examination. This heterogeneity mirrors the differences in clinical conditions and in the principal symptoms and complaints of in- and out-patients in primary and tertiary settings. It is interesting to note that PUD examinations were mostly used for confirmation — in two thirds of the cases — rather than for exclusion purposes.

When the PUD examination is considered as the index test and further testing as the reference standard, the overall diagnostic accuracy was 89%; the sensitivity 91%; the specificity 83%, the positive likelihood ratio (LR+) 5.4 and the negative likelihood ratio (LR-) 0.11. Even with the possible limitations inherent to the study design, the low LR- supports the use of PUD as a triage test before carrying out other more complex, and more costly, tests. In addition, since patients underwent further testing in the most difficult cases, e.g. when PUD interpretation was judged inconclusive by the examining physician, the accuracy of the PUD examination may even have been underestimated.

CONCLUSION

The findings of this study show that, after a brief period of simple training, a PUD-assisted examination can be successfully used by physicians in various settings for ten common clinical indications and considerably reduces the number of additional diagnostic tests needed. Adding a PUD examination to a physical examination is therefore a promising approach with the potential of reducing waiting times and healthcare costs.

REFERENCES

An ultra modern Swiss hospital focussed on orthopedics

Situated in Basel, Switzerland, the Merian Iselin Hospital for Orthopedics and Surgery is an ultra-modern, customer-oriented private clinic with a reputation for highest quality standards and the use of advanced technology to provide optimal services, not only to the patients, but also to referring physicians.

Recently the radiology department has invested in a new large-format display system. We wanted to find out more about the clinic in general and the equipment in particular so we spoke to Dr Thomas Egelhof, head of the radiology department.

Q. Please tell us about your hospital. Do you only specialize in orthopedic surgery or do you accept other cases?

The Merian Iselin Hospital for Orthopedics and Surgery is one of three large private hospitals in Basel, Switzerland and nationwide is one of the hospitals with the largest number of surgical interventions in knee, hip and shoulder surgery. A high majority of our patients come for orthopedics and surgery care but we also treat patients for urological and renal diseases, ENT, general medicine or neurology. We receive close to 7,000 patients every year with approximately 90% coming from all over Switzerland and 10% from other countries, such as Germany, France, Italy and some others. We benefit from an excellent reputation as can be seen from the fact that patients and physicians usually come to us through word-of-mouth recommendations.

Q. Now let’s turn to radiology. What personnel and equipment do you have to provide the service expected of you?

At the heart of the hospital is the radiology department, which creates imaging reports for both external and in-house physicians. More than 22,000 radiological examinations were performed in the department in 2015. To carry out these examinations, we have 5 radiologists and 15 technicians on board.

Q. In addition, you have recently acquired a large format – display system. What was the rationale behind this acquisition?

In our hospital we put a great emphasis on communicating directly with the referring physicians and patients themselves,
which we often do in our meeting rooms such as our multi-disciplinary team (MDT) rooms.

We found that common diagnostic monitors were not suitable for efficient communication and the many discussions we have between cooperating physicians, patients and us since they were far too small for large groups of people to gather around. The only large-format display technologies that were available before we acquired the new system were beamers and overhead projectors which had much lower resolution and therefore could not display detail with the precision and grayscale nuances we required.

We were seeking a new solution, one which would meet our requirements for resolution, grayscale and color quality and signal processing in UHD quality, which we felt would not only improve patient confidence but also further strengthen communication with the physicians. We take great pains to be a meticulous care provider and we are always looking to develop and improve.

We selected the NEC MultiSync X841UHD 8MP monitor which features a screen diagonal of more than two meters and DICOM mode for clinical review of X-ray images for use in our Multi-Disciplinary Team, MDT, room. An NEC Multi-Sync MD322C8, with the same resolution as the large-format display, is used as an input monitor for the radiologists. The two screens can be cloned on a pixel-to-pixel level to provide outstanding image quality without any loss of data or visual detail. Images remain stable regardless of the ambient room lighting and a non-glare surface restricts the effect of reflections on the screens.

The NEC MDT room solution is completed with a solid Wall Mount PDW T XL with integrated tilt function, offering the flexibility that is needed to adapt the screen installation to the individual requirements existing for each MDT room. A NVIDIA Quadro K2200 graphics card delivers exceptional power and efficiency to support the high graphics requirements for dual 8MP graphic displays. In addition, a Gold DisplayPort 10 m Cable from Lindy bridges the distance from the input source and the cloned 84-inch display, with the high quality required to deliver 4K UHD signals over a larger distance.

Q. How is the system performing in practice?

The system has now been up and running since last summer and we are extremely happy with it. The extreme level of detail achieved with the UHD resolution display permits more precise diagnoses and allows extremely low viewing distances. Medical image data and information are reproduced correctly thanks to precise calibration and the DICOM mode. Black is really shown as black, just as white is really white and gray is gray on the screen. A semi-matt surface restricts the effect of reflections on the screen.

Q. So now that it is up and running for what is the system most often used?

The solution provided by NEC is used now for Multi-Disciplinary Team meetings, patient appointments and staff training and education. The solution means in practice that hospitals such as ours can manage to increase productivity, as physicians can more easily view images in detail together.

This gives our hospital a huge competitive advantage through the increased levels of patient confidence. A good diagnostic monitor says more than 1,000 diagnostic words. With the use of the new meeting room solution, diagnostic images can be easily visualized and thus the credibility of the findings is increased, as lesions are shown in a clearer and more precise manner. This leads to less uncertainty for all concerned and increases productivity both in radiology itself as well as referring physicians and other associated medical specialists.

Q. And what about the future?

The experience we have now from actually working with the monitor screen solution has clearly improved our work flow and productivity and led to fewer inquiries and call-backs. We are now in active discussion about installing the monitor system in all our meeting rooms.
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The growth of 3D printing in biomedicine: applications in radiology

Three dimensional printing (3DP) has rapidly become an accessible method for the production of physical objects for use in many biomedical and clinical applications. The technology has progressively become available to consumer end-users thanks to a reduction in the cost of printers and print materials as well as to the development of simple print software.

This article summarizes the principles behind the main 3D printing techniques and describes some of the many medical applications of 3-D printed objects.

Today, three-dimensional-printing (3DP) has become a relatively inexpensive technology that allows the building of physical three-dimensional objects, in a layer-by-layer fashion, from their respective original, virtual models [1].

3DP may be used to rapidly generate physical models or prototypes, directly from different virtual datasets. The most common of which are those from computer-aided design (CAD), magnetic resonance (MRI) and computed tomography (CT) [2].

By using dedicated open-access post-processing algorithms, it is possible to extract a spatial model from such determined image datasets and export it in a machine-readable data format. Subsequently, data associated with this spatial model can then be used by specific and dedicated printers to generate a final product, the 3D object [3].

The relative simplicity and cheapness of this approach means that the possibility of printing physical objects is having increasingly significant implications in both biomedical and clinical applications.

Thus, 3DP has become progressively more available to consumer users thanks not only to a reduction in the cost of 3D printers and print materials but also to the development of simple, object-oriented, print software [4].

Currently available technologies

Today, thanks to the availability of advanced digital technology, the accuracy and efficiency of 3DP has reached remarkable heights. 3D scanning technology is used to obtain tissue surface data of a primary impression. Several different manufacturing processes have been developed over the years.

The most important and widespread both in biomedical and clinical context are briefly described below:

Stereolithography (SLA):

This method works by focusing an ultraviolet (UV) laser on to a photosensitive liquid resin vat. By using a computer aided manufacturing (CAM) or computer aided design (CAD) software, the UV laser is able to draw a pre-programmed design or shape on to the surface of the photopolymer vat. The photosensitivity of the photopolymers under ultraviolet light results in the formation of a single layer of the desired 3D object, thanks to the solidification of the resin. The process is then repeated for each layer of the design until the 3D object is complete [5-6].

“..The radiologist plays a key role in medical applications of 3D Printing.”

One of the advantages of SLA is the high quality of the printing process [7]. However, on the other hand, the SLA process is time-consuming and costly [8].

Selective Laser Sintering (SLS):

In this process, the particles of a powder bed are heated until they sinter, or melt, together. The heating is carried out through the use of lasers with powerful thermal capabilities (for example, CO₂ lasers). By altering the height of an adjustable table containing the powder bed, it is possible to build a 3D object. After the melting or sintering of one layer has occurred, a new layer of powder is then applied to the surface of the structure. The process is repeated, layer after layer, until the device is complete. Once the 3D structure is complete, the excess, un-used powder is removed [9].

A particular, advantageous feature of SLS is the possibility to use materials such as titanium and nylon to carry out the production of 3D structures with complex features [10].
However, the materials that can be processed by SLS have high porosities and consequently have surface roughness; in addition, the mechanical resistance of the finished product is frequently lower than that of the raw material [9].

**Digital light processing (DLP):**

This is a relatively fast top-down process, in which a digital mirror device (DMD) consisting of an array of micro-mirrors, which can rotate independently of each other is used to control the curing laser beam in on/off states [11]. DLP-based printers build objects using liquid photopolymer resins, which are selectively hardened by a light pattern for each cross-sectional slice of the object until the entire model is complete.

DLP is faster than SLA thanks to the fact that an entire layer can be cured at once [11].

The fast processing time of DLP is one of its most significant advantages, as well as its high accuracy and good resolution (voxel size: up to 30 μm versus 100 μm with conventional SLA printers), which results in high quality, smooth surfaces of the printed structures. These features make DLP an optimal technology for the rendering of geometry tissue engineering scaffolds [12].

However, a support structure is always needed in the technique. This is a disadvantage of this innovative technique [13].

**Plaster-based 3DP (PP):**

This process uses a mixture of dry powder and water to form a paste, which is then hardened by the application of heat and/ or air to evaporate a certain amount of water. In the PP process sections are printed first. An inkjet print head moves across a bed of powder, depositing a binding material (generally a liquid). Thus the part to be printed is obtained by the cross-sections of many thin layers of the model. During the process, thin layers of powder are progressively spread across the complete previous layer, and adhere to it, in order to obtain the desired shape in the sections until the object is complete. At this point, unused powder is removed. PP is capable of color printing each successive layer using normal inkjet cartridges, with no need for support materials.

However, PP always requires post-curing.

**Fused deposition modeling (FDM):**

This method is the most commonly used consumer 3D printing technology that is available currently. The method consists in extruding a series of thermoplastic materials, layer-by-layer, through two heated print nozzles. The process involves melting a thermoplastic polymer into a semi-liquid state (small drops). The head then extrudes the material onto the build platform. The process continues, fusing one layer with the next, until the entire 3D object is complete.

Two important benefits of FDM are its high porosity due to the laydown pattern and good mechanical strength [6-14].

In addition, FDM printers are much more common and inexpensive than other RP types.

A disadvantage for FDM is that it is limited to the use of thermoplastic materials with good melt viscosity [15].

**EVALUATION OF THE ACCURACY OF PRINTING**

In order to evaluate the accuracy of low-budget workflows based on the use of consumer commercially available 3D printers, we use FDM technology.

A group of test objects was scanned with a 64-slice CT in order to build 3D copies. CT datasets were worked up using a software chain based on three free, open-source softwares. Objects were printed out with a commercially available 3D printer. Overall, the mean absolute difference between the test objects and printed 3D copies was 0.23 mm. The mean relative difference amounted was 0.55 %.

These results suggest that an FDM-based 3D printer is a suitable and reasonable choice for a hospital that wants to provide 3D printing services independently of external commercial services [14].

**MEDICAL APPLICATIONS OF 3D PRINTED MODELS**

The radiologist plays a key role in medical applications of 3D Printing.

Both CT and MRI datasets can be used to develop 3D-manufacturing processes to build accurate, realistic 3D models or copies of anatomical structures and devices. These can provide reliable and sufficient anatomic information, and can be essential tools to better understand individual anatomy and to carry out experimental model testing devices [16].

The radiologist optimizes the CT scanning protocol to ensure the qualitatively best 3DP result, while avoiding, if possible an excessive use of X-rays, especially with pediatric patients.

**FIGURE 1.** Left panel: real object. Right panel: 3D copy; measurement shows that the mean relative dimensional difference amounts to 0.55 %.

**FIGURE 2.** Segmentation of meniscus from MRI datasets.
As for MRI, the radiologist should choose and optimize MRI sequences to obtain the best isolation and segmentation of the structures to be printed, especially if these are affected by the proximity of many other anatomical structures.

A 3D printed patient-matched model is an extremely useful tool for surgical planning and reconstruction, helping to validate surgical approaches and objects such as implants. The surgeon can then simulate surgery on the basis of the 3D printed replica, and can choose the best technique or equipment (for example by a pre-modelled metallic plate), thus improving the accuracy and clinical outcome of the intervention and reducing the length of time of the surgical procedure.

The finished model can also be sterilized and used for intraoperative guidance. A mold of an implant can help the surgeon shaping bone grafts or plates during surgery.

The principal use of 3DP in orthopedic surgery is in the manufacture of patient-specific implants and spinal and other devices.

A 3D printed fracture replica allows the surgeon to understand the features of the fractures before the actual surgical procedure and also results in a better visualization of possible bone gaps. The result is to increase the possibility of optimal patient treatment with quicker patient recovery and minimising chronic pain.

Liu et al., presented a modeling and visualizing system to assist surgeons in correct registration in closed long bone fracture reduction surgery, involving a virtual plate pre-bending based on axis pre-alignment. The system pre-operatively uses CT datasets and the geometric parameters measured on the plate models [17].

The production of patient-specific implants, which closely conform to the physical dimensions and mechanical requirements of the region of implanta
tion, has eliminated the constraints of shape, size and mechanical properties that exist with standard implants. In particular, custom implants for the reconstruction of craniofacial defects have recently gained importance thanks to their improved performance compared to their generic counterparts [18].

Lee et al. successfully tested in sheep a 3D-based therapeutic procedure to replace damaged menisci. They used a custom 3D printed scaffold to replace the meniscus, in conjunction with the infusion of stem cells, so at the same time stimulating the body’s spontaneous natural re-growth of the damaged tissue and regeneration of the torn lining [19].

Again, 3D-models have recently become more and more useful to study cardio-vascular pathologies, in particular to simulate surgical approaches and test new experimental treatment devices.

For example, Capelli et al. developed a detailed finite element (FE) model of transcatheter aortic valve implantation (TAVI), to investigate the effects of the implantation phases on the mechanical performance of the device and to estimate possible clinical outcomes, in order to evaluate the usefulness of the approach and so potentially increase the patient population which could benefit from this less invasive procedure.

FIGURE 3. Left panel: pelvic fracture, Middle panel 3D segmentation of the fragments, Right Panel: printed fragments.

FIGURE 4. Left Panel: fracture reduction, Right panel: pre-modeled plates on the basis of 3D printed patient-matched model.
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surgical treatment [20].

An experimental model of the internal carotid artery (ICA) has also been made for the research and testing of neurovascular devices [21]. In this approach images of ICA aneurysms from angio-CT datasets enabled computer simulation of the blood flow and improved the understanding of intraaneurysmal hemodynamics [22].

By using 3D-printing technique, a virtual surgical field can also be achieved. Zhen et al. represented in 3D several anatomical structures around the horizontal segment of the petrous region of the internal carotid artery, to facilitate the anatomic study and help the surgeon preoperatively identify the safe drilling area [16].

Schievano et al. demonstrated that FE analysis of a percutaneous pulmonary valve implantation (PPVI) device into a realistic anatomical implantation site could be used to improve patient follow-up and monitoring through analysis of the likelihood of stent fracture [23].

Finally, Park et al. used chest CT and 3D virtual modeling to assess whether a Total Artificial Heart (TAH) device would fit in patient’s anatomy as a pediatric cardiac assist in decannulated heart failure, in patients who are waiting for a transplant, as well as minimizing eventual postoperative complications [24].

This model could even allow implant design adjustments in realistic anatomy, which has not been altered by a surgical approach (e.g., thoracotomy) [25].

CONCLUSIONS

Nowadays, as shown in the studies cited above, there is easy availability of accurate and low budget 3D systems, which can be employed in different ways.

A 3D printed patient-matched model represents a useful tool. It provides reliable anatomic information, which is essential to better understand individual anatomy and perform experimental model testing of devices. Moreover, the surgeon can simulate surgery on the basis of the 3D printed replica, in order to preoperatively validate the implants and surgical approaches and to improve the accuracy and clinical outcome of the procedure.

The radiologist plays a leading role in 3D by helping to optimize the CT and MRI scanning protocol, to obtain adequate datasets and so to ensure the qualitatively optimal 3D result.

It is clear that close cooperation between the radiologist and the other medical specialists involved, is an essential factor and an added value for the hospital.

REFERENCES

RadPath: a Platform for Integrating Information in Cancer Diagnosis

Misalignment in diagnoses from radiology and pathology during cancer diagnosis can complicate the task of determining appropriate treatment. In particular, in the field of lung cancer, we have found that defining and measuring concordance between radiology and pathology is challenging [1] and can cause confusion for physicians who must aggregate and comprehend the diagnostic information in order to provide treatment. The goal of the project described in this article was to create an electronic platform, called RadPath, to efficiently integrate diagnostic findings from radiology and pathology, and proactively review them to ensure that downstream physicians receive a single, coherent, diagnostic message with information from both specialties.

SYSTEM OVERVIEW

We designed the RadPath system to integrate salient information documented during the diagnostic process into a single, interactive report [2]. The first step in this process was to discuss possible information sources, and the specific data elements within each source that should be highlighted. This discussion included considering the diagnostic importance of each data element (e.g., the Impression section versus the Technique section in a radiology report), as well as the temporal nature of the data source (e.g., pathology reports amended with molecular results). After deciding on a data prioritization, we developed an interface that would highlight high-priority data elements, but also make all elements easily accessible with minimal mouse clicks. Consideration was also given to legal implications of creating a web-based integrated report, and as a result, statements were added to clarify for users that a RadPath report consists of multiple clinical reports that may be accessed separately via our electronic health record (EHR). Additionally, a printable version of the report that contains all of the information available in the interactive web version is stored in our EHR’s document server.

As a result of our design process, we developed the RadPath report shown in Figure 1. The report consists of three panels: Correlation, Pathology, and Radiology. The information in each panel defaults to data points deemed high priority (e.g., Final Diagnosis), but also allows the user to select different information via a tabular design. The Radiology and Pathology panels structure previously acquired information, including diagnoses, findings, and key images. The Correlation panel synthesizes the findings and diagnoses from the previous radiology and pathology studies into an integrated recommendation. For example, if both radiology and pathology diagnoses are in alignment, the Correlation component conveys that the two diagnostic areas are in agreement regarding the diagnosis of the suspicious nodule. However, if diagnoses are conflicting, or if there is additional contextual information that can aid the referring physician, the Correlation panel highlights how previous study results are not aligned, and may recommend a subsequent action (e.g., repeat biopsy). The three information panels are created in semi-automatic fashion with physicians in the loop.

RadPath reports may be initiated by either a radiologist or a pathologist. To begin a report, a physician logs into the online RadPath system and enters the medical record number of the patient undergoing diagnosis. Depending on the user (e.g., radiologist vs. pathologist), the RadPath system then pulls a relevant set of reports. The physician selects the report(s) relevant to the current case, which are then automatically structured by RadPath to highlight salient information. The system also retrieves key images based on mentions in report text. For example, when a radiologist mentions a key image in the diagnostic report (e.g., mentioning a key image in terms of series-slice, such as “4-45”), RadPath will pull the image from our PACS and convert it into a compressed format for display. The structured report is then displayed to the physician, who has the opportunity to refine the presentation of information or correct any structuring mistakes. Typically, the pathologist will initiate the RadPath report, and once the pathology side of the report is completed, the radiologist is notified via email that a report is pending their approval. The radiologist then logs into the system, reviews the previous generated diagnostic information from both radiology and pathology, and then completes the Correlation panel. It is important to note that previous reports pulled and structured by the system are immutable in terms of their information content. The only place where new information may be added to the RadPath report is in the Correlation panel. When the report is finalized, a message is sent to the referring physician notifying him/her of the report’s availability. The report is accessible through hyperlinks that appear in the diagnostic radiology and pathology studies. The hyperlinks appear under a “RadPath Integrated Report” heading, and direct the user to the RadPath application web server.

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DISCUSSION

During the implementation process there were several challenges we encountered. First, we had to decide if the radiologist or the pathologist should complete the Correlation panel. After discussion, it was concluded that it is primarily the radiology side that would be adding additional context to the case (e.g., reflecting on the pathology diagnosis having knowledge of the biopsy procedure), and that therefore completing the Correlation panel would be radiology’s responsibility. Next, there was a need to specify the radiologist who should be responsible for generating RadPath reports. There was debate as to whether it should be the diagnostic radiologist or the interventional radiologist (IR) who performed the tissue sampling. Ultimately, it was felt that the IR would be most appropriate given his/her first-hand knowledge of the interventional procedure. Finally, there were concerns from physicians regarding “correcting” the previous diagnoses from their colleagues during correlation. These concerns were ameliorated through the implementation of a drop-down list of structured Correlation and Action items [see Figure 1] that allow the RadPath radiologist to select pre-formatted statements. However, there is always the flexibility to provide free-text comments.

The RadPath report is currently being used to support lung cancer diagnosis, with plans to support prostate cancer diagnosis in the near future. Adding additional diagnostic areas requires revisiting steps in the design phase, and specifying priority information elements. Over the first year the system was deployed, 60 reports were created. On average, each report requires 128 seconds from the radiologist and 93 seconds from the pathologist to complete. To gauge the utility of the RadPath report to downstream users, we conducted a survey of two surgeons, one oncologist, and two pulmonologists. Survey results indicated that RadPath reports are helpful tools, and that the Correlation panel is especially useful when additional diagnostic actions are suggested. Furthermore, one of the biggest advantages for downstream physicians using the RadPath system is that they no longer must hunt through the medical record to find each individual report of relevance to a case, as it now all appears succinctly in one interactive web page.

CONCLUSION

RadPath is being deployed to a larger user base and extended to additional diagnostic domains. In addition, new features are being added to the system, including support for semi-automatic correlation using natural language processing and quantitative research diagnostics developed through large-scale analyses of our institution’s data warehouse. With the increasing complexity of medical diagnostics that require a team-based approach to implement, the RadPath system provides a platform for expediting information sharing and communication between physicians during cancer diagnosis. Future work will expand RadPath’s capability to include treatment information, enabling the visualization of temporal disease information and therapy response.

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Agfa HealthCare gets serious about integrated care

The recent announcement from Agfa HealthCare that it has invested in, and will be actively collaborating with the US-based healthcare IT company, MphRx is just the latest development in a deliberate step-by-step strategic development policy. This has taken Agfa from its strong roots in medical imaging, through the development of enterprise-wide imaging and electronic medical records into the high potential field of Integrated Care.

We thought it was time to catch up with Agfa and find out what’s going on in Integrated Care and how the company views the future of this actively growing sector, so we spoke to Hans Vandewyngaerde, President of Agfa HealthCare EMEA region.

Q. To begin with, let’s deal with the terminology and be absolutely sure that we know what we are talking about. What exactly is Integrated Care?

It’s true that there are several terms in current usage which describe what is basically the same concept, which we refer to as Integrated Care. For example HIMSS uses “continuity of care” while in the UK they often use “converged care” but in the end what we are all referring to is a multi-disciplinary, multi-agency collaboration whose objective is to meet the medical and social needs of the individual. By multi-agency I mean the combination of different functional departments within the hospital — and outside the hospital — in a mixture of social and acute care, with the common feature being that the patient is at the center of the whole process. In short integrated care is the linking of multiple levels of care management and delivery, the coordination of patient-oriented services and the collaboration of the various professionals and care-givers who deal with the patient across these services.

Q. And what’s driving this focus on integrated care?

Of course, this is not just an academic exercise. There are several real-world factors behind the push to integrated care, although naturally enough they can vary a little from country to country, or from one particular healthcare system to another.

However the common feature is that all health systems are facing growing financial pressures. People are living longer and patients are increasingly suffering from long-term chronic diseases requiring sustained attention. In addition patients feel much more empowered than they used to be and are being increasingly vocal in their demands and requirements.

It is to meet such challenges that organizations are turning to integrated care approaches, which firmly put the patient at the center of things.

Q. Intuitively the rationale for integrated care makes sense. But in practice how is the efficiency of the approach measured?

Yes, in the hard reality of today’s healthcare economy, it is important to be able to evaluate and cost the outcome of the approaches. And just as there are differences in national health systems, so there are differences in the way integrated care is measured.

In the UK, they have established several Key Performance Indicators (KPIs). For example in the case of a chronic disease one KPI could be a shorter stay in the hospital or that an acute episode in the course of a chronic disease is shorter. It is more than just the simple traditional accounting exercise of calculating financial benefits but also includes attempts to evaluate the whole patient experience. For example for a patient diagnosed with prostate cancer, the classical evaluation of cost benefit involves the cost of diagnosis & therapy in the hospital versus the probability of a successful outcome. However once out of the hospital, the patient is likely to have many more down-to-earth questions such as risk of incontinence, infertility, etc., etc., which go beyond purely financial and insurance reimbursement issues.

Ultimately it is still a question of “efficiency” but with efficiency now being evaluated over a much broader remit.

Q. And in general how are hospitals reacting?

Well, for sure, if the hospitals aren’t incentivized in one way or another they aren’t going to adopt integrated care just for the fun of it. Mostly they can see the overall advantages. In many countries, the governmental authorities are actively putting pressure onto the hospitals to adopt integrated care for the reasons we talked about earlier, e.g. budget pressures, the best ways to deal with the aging population, etc.

Again there are significant differences between countries in...
terms of the implementation of integrated care approaches. The Nordic countries and The Netherlands are generally further ahead, but the UK is also catching up fast. Incidentally in the UK they have adopted a devolved approach where, via the regional funding authorities, the government is putting pressure on the various communities to integrate acute care, social care and medical logistic care aspects together on one single platform, not just in the interests of the patient but also for overall cost issues.

The more the issue is forced downwards the more it is obvious to the hospitals of the value of breaking down barriers between themselves and outside agencies — and also for that matter of breaking down the traditional barriers that have existed between many in-hospital departments. The turf war between cardiologist and radiologist is a classic example.

Q. You mention radiologists, so what’s their role in this grand new scheme of things?

Our vision of the future role of radiologists is that they will develop on the one hand into what could be considered a role of “competence” in terms of image management, where they will deal with all the general aspects of image management. In addition of course there will always be a role for really specialist radiologists who will deal with all the general aspects of image management. In addition we will, of course, continue to develop our step-by-step development policy. Thus, ten years ago we took a strategic decision to enter the Electronic Medical Record (EMR) sector. This means acquiring an in-depth understanding of how to handle data, especially clinical data where the combination of data and images is crucial. The solid expertise that we have acquired in this area means that the next steps, namely those to the Electronic Health Record (EHR) and from there to fully Integrated Care are quite accessible.

Q. And what does Agfa bring to the party?

Well as you know Agfa has a long and valuable tradition of being in the medical imaging field, but — particularly over the recent years — we have continually evolved in a deliberate step-by-step development policy. Thus, ten years ago we took a strategic decision to enter the Electronic Medical Record (EMR) sector. This means acquiring an in-depth understanding of how to handle data, especially clinical data where the combination of data and images is crucial. The solid expertise that we have acquired in this area means that the next steps, namely those to the Electronic Health Record (EHR) and from there to fully Integrated Care are quite accessible.

Q. And in practice how will you do this?

Well, we see the EHR — which is a much broader, more patient/population-oriented record than the classical EMR, which is restricted to medical/hospital information — as being the key to the door of integrated care.

Which is why we have made our recent investment in the US-based company MphRx in which we have taken a 27% equity stake. Now, with our access to the MphRx platform, we can provide specific use cases around imaging and data on EHR portals. We have already created a patient centric and agile portal for Integrated Care that can be used by care providers ranging from single facilities to large regional deployments. Admission assessment and questionnaires and post discharge workflows can generate measurable benefits already today in a regular DRG world. We will soon add Community Scheduling that will further create cost savings, while at the same time building a foundation for the future of care delivery.

Of course we at AGFA are not the only healthcare IT company dealing with EHRs but our additional strength and competitive edge lies in our ability to handle the combination of data and images where we have vast experience.

But that’s not the only development we have introduced recently. We are also launching our Business Intelligence platform.

Q. What precisely is the role of the Business Intelligence platform?

In a way this gets back to our earlier discussion of the metrics used to evaluate the efficiency of a process. Business Intelligence solutions are ever-more important for hospitals, since the increasing cost pressures in healthcare can only be efficiently managed in the future using specialized analytical tools.

There are many data mining systems out there which can search data for analysis but real comparative analysis depends on the compatibility of the underlying data.

For example if a group healthcare manager wants to compare the performance of the radiology department in one hospital with that in another hospital, first you have to make sure that the basic data in the two hospitals is in a compatible format before any comparative analysis can be carried out. Our new BI platform is capable of allowing such comparisons.

The use is however not just restricted to radiology — BI analytics can also be used for wider hospital management and administrative analysis, tracking financials, outstanding bills, etc. The particular uses of BI analytics that the hospital makes of the platform is of course up to the hospital.

But this is just the latest cherry on the cake. I hope the underlying rationale behind our step-by-step progress to Integrated Care from enterprise-wide imaging through EMRs and EHRs is clearer.

And while the Integrated Care field is still in relative infancy, what is very gratifying to us is that already we have had many large healthcare organizations, in Europe and the United States who share our vision and are implementing our systems.

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150 countries over 10 000 abstracts submitted
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Analysis of a Four-Point Order-Priority Score on Imaging Examination Performance Times in the Emergency Department and Inpatient Setting

Ordering systems for imaging as well as laboratory and other ancillary services have historically employed the “traditional” priority categorizations: STAT, ASAP (as soon as possible), and routine. In such systems, the ordering provider selects one of these categories to indicate the relative urgency of the order. These terms can lead to ambiguity or misuse, especially if they are left undefined [1, 2]. As evidence, at one academic medical center, 74% of the orders for portable chest radiographs were ordered as STAT [2].

The benefit of mere binary prioritization compared to no prioritization has been documented [3-5], however, established schema for guiding order prioritization in more modern and complex healthcare scenarios which need more than two levels of priority are largely absent. "One could argue that all emergency department (ED) orders should be STAT, rather than routine, given patient expectations and institutional throughput requirements, however this binary system fails the patient who is in a code category, stroke alert, or trauma alert, because the urgency of their situation is ‘diluted’ by other STAT orders that are less clinically time sensitive [8]”.

Providers at the “bedside” are clearly best situated to know the relative urgency of an imaging examination and its likelihood of altering management. However, providers may be challenged in relaying this information effectively if the ordering system lacks clear and appropriate guidelines for priority categorization or is too simplistic to handle a myriad of clinical scenarios. In March 2011, our institution implemented a new electronic health record (EHR; EpicCare; Epic Systems, Verona, Wisconsin) and radiology information system (RIS; Radiant; Epic Systems). We took this occasion to revise our imaging order prioritization schema in an attempt to address the limitations inherent to our traditional model of prioritization for both inpatient and emergency department imaging requests. More specifically, 1) order-priority categories were made numeric, and 2) each numeric category was accompanied by a brief clinical definition to assist the referring provider in selecting the relative urgency of the exam.

We hypothesized that our institution’s new or at least redesigned model would result in desirable prioritization of imaging examination performance by appropriately stratifying median turnaround time and turnaround time consistency by level of priority. The purpose of the study reviewed here was to retrospectively evaluate the impact of this defined numeric order-priority system on the prioritization of imaging examinations at our institution.

Four-Point Order-Priority System
Our revised order-priority system for inpatients and emergency department patients was implemented in March 2011, and specified four graded categories (priorities 1-4, with 1 being the most urgent). Representative clinical scenarios accompanied each order priority and were visible at order entry. Priority levels are depicted in Table 1, and referring providers received a three-minute tutorial on this new model of prioritization during their EHR training. Furthermore, a programming feature made the selection of a priority category a “hard” requirement before the order could be submitted. To evaluate our new prioritization schema, we selected two variables for comparison to a control: Order to Performance Time (OTPT) and Consistency (of order to performance time).

Median OTPT: Distribution-free randomization tests were used to compare the medians (assessed individually for each imaging modality: CT, MRI, Ultrasound, Radiography) of the OTPT empirical distributions in a pairwise manner between the four order priority levels [6]. We also evaluated OTPT for a combined data set including all tested imaging modalities (CT, MRI, Ultrasound, Radiography).

OTPT Consistency: Interquartile range (IQR) length of the empirical OTPT distribution was used as an estimate of the consistency of OTPT. Using distribution-free randomization tests, both the individual and combined-modality OTPT data sets were used to provide “inter-order priority-level comparisons of OTPT consistency [8].”

Comparison of Median OTPT and OTPT Consistency to Control Data: Combined-modality data were used to compare median OTPT and OTPT consistency between the traditional (Pre-implementation: STAT, ASAP, Routine) and revised (Post-implementation: Priority 1, 2, 3 and 4) priority categorizations. Prior to making this comparison, which was known to be somewhat limited, we evaluated and confirmed that the percentage of examinations representing each modality (i.e. modality frequency distribution) was similar between the traditional and revised order priority time periods. The following comparisons were made:

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RESULTS

OTPT Distributions in the Four-Point Order-Priority System: With the exception of Ultrasound (where priority 2 examinations were completed slightly more rapidly than priority 1), the higher priority imaging requests were completed more rapidly than those indicated as less urgent. Figure 1 [8] displays the median and interquartile range of the OTPT empirical distribution. For a detailed summary of the OTPT distribution for the mean, median, and measurement consistency, the reader is referred to the original article [8].

Comparison of Pre- and Post-Implementation Data:

We present the results from the comparison of OTPT and OTPT Consistency for the combined (MRI, CT, Ultrasound, and Radiograph) modalities between traditional and revised order priority models (pre- and post-implementation periods, respectively). Of note, there was a large bias toward lower OTPTs in the control (pre-implementation) group due to the inability to exclude studies whose orders were changed/corrected immediately prior to exam performance, which led to artificially short order-to-performance-times. In spite of this bias, priority 1 studies (post-implementation) were performed with significantly shorter median OTPT’s compared to STAT and ASAP examinations under the post-implementation model.

Table 2 presents results, including P values, from comparisons of OTPT and OTPT consistency for prioritized and routine examinations under the new model (2011-2013; four-point order-priority) versus control (ie, 2010; the pre-implementation period with the traditional model). Despite the recognized bias toward OTPT in the control group (ie., the inability to exclude studies with changed orders immediately prior to the exam thereby resulting in unreasonably short OTPTs), priority 1 studies in the new model were performed with a significantly smaller median OTPT than were STAT or ASAP examinations under the traditional model.

Conclusions and Future Directions:

Coinciding with the launch of a new EHR in 2011, our institution went live with a revised model of prioritization for imaging requests. In order to address the limitations of our conventional model, which employed the prioritization categories STAT, ASAP, and Routine, our new system had two key features: 1) Numerical catego-

Table 1. “Clinical definitions for the new numeric order priority system as provided to the clinicians during a brief training session prior to implementation. Institutional definitions inform ordering providers about appropriate clinical scenarios for each level of priority, eliminating guesswork and potentially reducing the misuse or overuse of high priorities. Priority 1 is established as a more urgent category above what is commonly considered STAT at other institutions (e.g. most Emergency Department exams; our Priority 2) so that providers can better communicate the most truly time-sensitive minority of exams to technologists to perform first. The term “routine” has been replaced by “most inpatients” to indicate that most inpatients will be done “as soon as possible” presuming there is not a more urgent clinical scenario to be addressed first. The system is numerical to communicate clear hierarchy regarding level of urgency to the technologists and other parties.” [8]

<table>
<thead>
<tr>
<th>Priority Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-CriticalAlert</td>
<td>Absolute most urgent studies; used sparingly; eg, smoke alarms, trauma alarms, codes, operating room emergency</td>
</tr>
<tr>
<td>2-Emergent/Inpatient spine</td>
<td>ED unrelated trauma, as well as most other ED patients; trauma spine clearance on inpatient clearance.</td>
</tr>
<tr>
<td>3-Urgent/Discharge pending</td>
<td>Urgent patients and other acutely ill inpatients as well as inpatients whose procedure or discharge are dependent on their exam.</td>
</tr>
<tr>
<td>4-ASAP Most inpatients</td>
<td>Default for most inpatient exams not defined above; performed ASAP after most urgent exam.</td>
</tr>
</tbody>
</table>

FIGURE 1. “Graphical distribution summaries for order-to-perform time (OTPT) after implementation of the new model for prioritization (2011-2013). OTPT was defined as the time in hours between the order placement and the technologist exam completion. Note that the red horizontal lines identify the median of the empirical distribution, while the length of the box identifies the length of the interquartile range (i.e. the length in hours between the OTPT at the 25th and 75th percentiles). A successful method of prioritization should yield the shortest and most consistent order-to-perform times for high priority studies. Median OTPT and OTPT consistency (i.e. IQR length) should be stratified by hierarchical levels of priority.” [8].
and consistent imaging performance times. 

ated clinical definitions leads to more rapid order-prioritization scheme with associ-

order entry.

MARCH 2016

2) A brief clinical definition accompa-
rization of exam urgency (i.e. 1, 2, 3 and 4), and 2) A brief clinical definition accompa-
ying each priority number, displayed at order entry. 

Our evaluation reveals that a numeric order-prioritization scheme with associ-
ated clinical definitions leads to more rapid and consistent imaging performance times for the highest priority studies, thereby tri-
aging care to the most acute clinical sce-
narios. Of note, the transition from our traditional to revised order prioritization schema had an associated decrease in the percentage of “most urgent” and increase in the percentage of “less urgent” examina-
tions (see full article for details) [8].

Association of an imaging request prior-
ity with a clinical location or scenario pro-
vided guidelines for ordering providers. This led to a more reliable and consistent “com-
munication” of the information most rel-

vant for technologist prioritization of exam completion. Notably, this led to a smaller percentage of the highest priority orders.

This model for order prioritization is not limited to imaging exam performance, and has potential applicability to labora-
tory orders, specialty consultations, and other ancillary services. In addition to the prioritization of exam completion, for results requiring physician interpreta-
tion such as those in medical imaging, an additional level of prioritization could be applied to the relative urgency of issuing a final interpretation [9,10,11].

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tional use of ORDER PRIORITY for the priori-


Table 2. “Clinical definitions for the new numeric order priority system as provided to the clinicians during a brief training session prior to implementation. Institutional definitions inform ordering providers about appropriate clinical scenarios for each level of priority, eliminating guesswork and potentially reducing the misuse or overuse of high priorities. Priority 1 is established as a more urgent category above what is commonly considered STAT at other institutions (e.g. most Emergency Department exams; our Priority 2) so that providers can better com-
municate the most truly time-sensitive minority of exams to technologists to perform first. The term “routine” has been replaced by “most inpatients” to indicate that most inpatients will be done “as soon as possible” presuming there is not a more urgent clinical scenario to be addressed first. The system is numerical to communicate clear hierarchy regarding level of urgency to the technologists and other parties.” [8]
The development of an enterprise-wide imaging strategy is now a major priority for healthcare providers across Europe. As patient demand increases, the queue for diagnostic imaging services is getting longer. However, an ongoing pan-European shortage of radiologists has meant that balancing supply and demand is now a persistent challenge. The issue is particularly resonant in the UK, where the battle to reduce diagnostic waiting times and accelerate patient access to treatment is once again putting the UK’s National Health Service (NHS) radiology services under mounting pressure.

According to the U.K.’s Royal College of Radiologists (RCR), the number of MRI and CT scans performed in the UK in the past decade has grown by between 10-12% each year [1]. At the same time, the number of trained radiologists in NHS trusts has fallen to become one of the lowest per capita in developed European countries [1]. The RCR estimates that in England alone the NHS currently has a shortfall of around 200 consultant interventional radiologists required to deliver standard 5-day services [1], while the limited availability of diagnostic imaging at weekends has been flagged by government as a key area for improvement.

New technologies have the potential to provide a simple solution to the staffing, workflow and quality issues currently surrounding radiology. The most progressive organisations are now recognising the important role that enterprise imaging solutions can play in helping them meet the dual challenges of delivering integrated care and effect meaningful change right across their local health economies. In Ireland, for example, the recent deployment of the National Integrated Medical Imaging System (NIMIS) is playing a major role in transforming patient care.

C-LEVEL VIEW

The key drivers for radiology procurements in the UK have evolved considerably in recent years. There is now widespread recognition that technology procurement can no longer remain a departmental decision. Indeed, as it becomes clear that connecting data across departmental boundaries can drive improvements to patient care, systems procurement has become firmly established as a Board-level strategic decision with enterprise-wide considerations. This is certainly the case with diagnostic imaging.

Radiology is so often the patient gateway to the appropriate treatment pathways, but flaws in traditional methodologies have meant that vital radiology data may not necessarily follow the patient as they journey across the care pathway. In many cases even access to images and reports within NHS organisations is constrained by departmental walls. The impact on patient flow, escalation, diagnosis and treatment can be severe. Managed poorly, radiology can regress from being a gateway to the appropriate pathway to being an inadvertent barrier to it.

Moreover, as ‘vanguard’ sites take up their mandate to explore innovative models of integrated care, service delivery is expanding to cross organisational boundaries. It’s no longer enough to know what’s going on inside your organisation, there’s a need to understand and connect with what’s happening outside of it. This is forcing senior management to develop an enterprise-wide view of their operations and patient populations, where the ‘enterprise’ stretches across entire local health economies.

ABOARD THE ENTERPRISE

So how can organisations remove historical obstacles that undermine radiology’s position as the gateway to critical care? The answer may well depend on making the move to an enterprise imaging solution. Enterprise imaging solutions are not only aligned with national directives to develop integrated services, but they can also help individual organisations address the many pressures on radiology.

SOLVING THE STAFF SHORTAGE

At present, the most common approach to the shortage of radiologists is to outsource services to a private provider. The cost implications of outsourcing alone are significant – but the approach also carries additional risks around quality. NHS organisations have no arbitration over the processes.
capabilities and quality of private providers, nor the standards
of clinical reporting being supplied. However, next generation
enterprise imaging systems could offer a solution to the work-
force problem. Not only can they provide real-time access to
images and reports to professionals across the health economy,
irrespective of their clinical setting, they also enable a platform for
collaborative working across sites. This means that organisations
can optimise resources across multiple settings, providing speedy
access to available radiologists and helping to balance workload.

In addition to helping maximise bandwidth, collaboration

“...Managed poorly, radiology can regress from
being a gateway to the appropriate pathway
to being an inadvertent barrier to it...”

in this manner helps accelerate care whilst maintaining quality
control. By including workflow tools that support the manage-
ment of resources across organisational boundaries, the most
effective systems will provide a safe and reliable foundation for
collaborative working.

DRIVING QUALITY GAINS AND PATIENT SATISFACTION

Although the journey towards collaborative working may
well be an incremental one, for Trusts that aren’t yet ready to take
this route, enterprise imaging solutions still provide significant
benefits for clinicians and patients alike. The best offer interop-
erability with existing systems to empower clinicians across the
enterprise with ready access to key patient data. This not only
supports clinical decision-making with up-to-date imaging and
reports but it helps improve patient/clinician interaction and
helps accelerate treatment. Real-time access to data can help
remove unnecessary delays, reduce the administrative burden
on the NHS and improve operational efficiency. Moreover, the
associated gains free up clinicians to see more patients, further
clearing the system. The impact on patient satisfaction and health
outcomes can be profound.

In health economies that have already embraced the enterprise
concept, the results – like the images – are there for all to see.
For example, in Ireland, the National Integrated Medical Imaging
System (NIMIS) now connects 37 facilities and 50 hospitals
across the whole country using a single PACS and RIS database.
It has fundamentally changed healthcare delivery and means that,
irrespective of where they touch the health service, patients and
clinicians have instant access to all their diagnostic images. The
approach can easily translate to the NHS — and further afield.

CONCLUSION

As health and care expectations change in line with societal
and technological evolution, it may be time for the NHS – and
indeed other healthcare systems across Europe – to consider an
alternative approach to imaging. With the landscape set to be
redrawn by the emergence of new integrated care models and a
wave of radiology procurements, the opportunity to be enterpris-
ing is right in front of us.

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**Book review**

**Ultrasound: The Requisites, 3rd Edition**

*By Authors: Barbara S. Hertzberg & William D. Middleton*

*Pub By Elsevier, 2016, 656 pp, € 75.59*

This bestselling volume in “The Requisites” Series provides a comprehensive introduction
to timely ultrasound concepts, ensuring quick access to all the essential tools for the effective
practice of ultrasonography.

Comprehensive yet concise, Ultrasound covers everything from basic principles to
advanced state-of-the-art techniques. This title perfectly fulfills the career-long learning,
maintenance of competence, reference, and review needs of residents, fellows, and practic-
ing physicians.

The book covers the spectrum of ultrasound use for general, vascular, obstetric, and gynec-
ologic imaging and features ully illustrated design includes numerous side-by-side cor-
relative images. It is written at a level ideal

for residents seeking an understanding of the basics, or for practitioners interested in lifelong
learning and maintenance of competence.

The book allows exploration of the exten-
sively updated and expanded content on
important topics such as practical physics
and image optimization, the thyroid, salivary
glands, bowel, musculoskeletal system, cervical
nodal disease, ectopic pregnancy, early preg-
nancy failure, management of asymptomatic
adnexal cysts, practice guidelines - and a new
chapter on fetal chromosome abnormalities.

The complete spectrum of diseases can
be visualized with many new and expanded
figures of anatomy and pathology, additional
correlative imaging, and new schematics dem-
onstrating important concepts and findings.
ShearWave Elastography and Breast Imaging

At a busy breast imaging facility in Florida the advanced ultrasound technique, ShearWave Elastography (SWE) has altered the way women are cared for both for benign and suspicious findings. SWE has reduced the number of benign lesions mistakenly flagged for biopsy, significantly decreasing the false positive rate of ultrasound. The technique has also helped reduce the initial level of false negative diagnoses in patients who ultimately are found to have breast cancer. This article describes the role ShearWave technology plays in the breast imaging center and gives examples of cases in which it assists in refining the ultrasound diagnosis.

Florida is not one of the 22 current “breast density” states in the United States which have a legal requirement that women must be informed of their personal breast density. Nevertheless, for the last five years, the Christine E. Lynn Women’s Health & Wellness Institute, in the Boca Raton Regional Hospital in Florida has been proactively educating patients at the time of their exam and informing them of their personal breast density and their US National Cancer Institute (NCI) Lifetime Risk of developing breast cancer. At the same time, women with high breast density are informed of the supplemental screening tools available. These include ultrasound, both 2D imaging and with ShearWave Elastography, molecular breast imaging and MRI. A formal risk assessment program is also available such that an appropriate personalized screening plan can be developed for interested women.

As most women with high breast density are not at extreme risk requiring MRI, bilateral whole breast ultrasound is offered to the majority of patients. Several studies have been reported over the last decade showing the improved sensitivity in breast cancer detection when ultrasound is added to mammographic screening of patients with dense breasts. However, a high false positive rate and low PPV3 of the generated biopsies have also been reported. (PPV3 is otherwise known as biopsy yield of malignancy or positive biopsy rate, PBR).

The ultrasound BI-RADS lexicon relies on lesion morphology to include evaluation of the margins of a mass, its internal characteristics, and posterior and local features to standardize the interpretive criteria. In the 1980s, Doppler analysis of lesions assisted the physician by providing additional information regarding lesion vascularity, with a resulting improvement in the specificity of the interpretation. Nevertheless, many women were still undergoing unnecessary biopsies for benign disease.

To minimize the number of such biopsies of benign lesions and to maximize the identification of those

Case 1. Oval circumscribed hypoechoic solid mass. Homogenously blue on SWE consistent with soft lesion. Biopsy proven fibroadenoma. Could have been given BI-RADS 2 or 3 rather than BI-RADS 4A requiring biopsy.

Case 2. Oval parallel slightly lobulated hypoechoic solid mass. Significant stiffness within lesion and surrounding tissue with marked heterogeneity. Invasive ductal carcinoma grade 3. Will not be mistaken for a benign lesion with SWE findings. SWE decreases false negatives.
patients who truly need biopsy, ShearWave Elastography can, for every lesion found by ultrasound in the breast, provide the clinician with supplemental information on the local tissue stiffness.

Clinical breast diagnosis is in part based on the stiffness or hardness of a palpable mass to suggest its etiology. Physical exam findings of breast malignancy date as far back as 2100 BC; nowadays, the breast imager can use information on the stiffness of a lesion and its surrounding tissue to suggest an accurate diagnosis.

In practice, SWE is rapidly acquired in a real-time setting and provides reliable, reproducible information non-invasively. The Aixplorer instrument from SuperSonic Imagine, the company which pioneered the technology, was cleared by the FDA in 2013 for its real-time quantification of tissue elasticity as expressed in kilopascals (kPa) and m/s.

The speed of the shear wave generated by the UltraFast scanner is imaged, quantified and color-encoded by the system which operates at 5,000 frames per second. The technology enabling the interpretation of fast moving shear waves, is at the base of the system's UltraFast platform which acquires images 200 times faster than conventional ultrasound systems. The system generates a two-dimensional, color-encoded map of tissue elasticity superimposed on a B-mode image of the same area for anatomical correlation. The information on the viscoelastic properties of breast lesions and their surrounding tissue can improve diagnostic accuracy.

Occasionally it can be seen that the stiff tissue of a malignancy will include not only a part or all of the tumor itself but also surrounding breast tissue. This may be due to a local increase in oncotic pressure surrounding a cancer due to leakage of fluid from tumor-induced neo-vascularity as a result of leaky basement membranes. Additionally, it has been suggested

Case 3: Small superficial hypoechoic solid mass appearing slightly taller than wide. SWE shows heterogeneity with significant stiffness. Invasive ductal carcinoma grade 1. Lesion will not be mistaken for a benign finding. SWE decreases false negatives.

Case 4: Deeply positioned hypoechoic mass with slightly indistinct margins. Lesion does not propagate shear waves consistent with fluid. Aspiration found a cyst. Aspiration could have been avoided with the use of SWE, changing BIRADS 4A to BIRADS 2. SWE decreases false positive findings on ultrasound.
that a local desmoplastic reaction may add to stiffness in the tissues surrounding a cancer or that there is increased collagen cross-linking with abnormal collagen fiber alignment. Such mechanical properties of the tissue cannot be seen on pathological examination.

MAJOR ADVANTAGES OF SWE
A major advantage of SWE is that the results are not dependent on the expertise of the operator, neither when the results are generated from individual scans nor from scans of the same patient by different operators or at different times.

In practice, the system’s color mapping capability has become an important tool for the training of the technologists in our facility. Through the morphologic assessment of a specific lesion the likelihood of malignancy can be assessed. When a benign lesion is suspected morphologically, the amount of transducer pressure on the breast can be varied to result in the appearance of a benign lesion (blue).

CLINICAL ADVANTAGES OF SWE
ShearWave Elastography improves the management of the breast cancer patient; the examinations are accurate and reproducible. In a study of 1800 patients using the Aixplorer system the results clearly showed that SWE helps reduce negative biopsies. In fact the PPV of lesions evaluated by SWE and BI-RADS morphology characteristics together as compared to BI-RADS alone increased from 52.6% to 67.1% with a p < 0.001. In addition, by adding SWE parameters to BI-RADS assessment of sonographic lesions, approximately 90% of BI-RADS 4a lesions could be downgraded to BI-RADS 3, thereby avoiding an unnecessary invasive procedure.

Elastography also has prognostic potential as increased stiffness is found in tumors of higher grade, of larger size and with a greater likelihood of lymphovascular invasion and nodal involvement. The stiffer tumors are also more likely to be HER2+ and triple negative.

The series of cases illustrated in this article show some of the clinical applications and resulting benefits of real-time, quantified and color-mapped SWE.

CONCLUSIONS
In our facility, ShearWave Elastography has significantly improved the quality of care and overall diagnostic performance of our physicians when breast ultrasound is performed. The technique gives us the ability to reliably downgrade a sono- graphic lesion from one of low suspicion requiring biopsy (BI-RADS 4a) to one of low suspicion not requiring biopsy (BI-RADS 2 or 3). This has resulted in our recommendation of whole breast ultrasound in patients with elevated risk or breast density in order to achieve supplemental cancer detection above that detected with mammography alone. Additionally, with the information provided by SWE, we are able to better triage patients requiring biopsy, prioritizing those most likely to harbor a malignancy thus enabling swift diagnosis and treatment.

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Echocardiography in Pediatric and Congenital Heart Disease: From Fetus to Adult, 2nd Ed.

This comprehensive textbook on the echocardiographic assessment of pediatric and congenital heart disease has been updated for a second edition with an emphasis on new technologies. The highly-illustrated full-color reference contains 1200 figures, and 600 video clips on a companion website.
- Fully updated, with new chapters on the assessment of the post-Fontan procedure patient and on pregnancy and heart disease
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- Written by experts from the leading centers around the world, with numerous new authors
- Revision emphasizes new technologies and quality of images
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A flourishing private practice focussed exclusively on diagnostic mammography

Dr Pierre-Alain Goumot is a radiologist who has specialized in breast imaging for many years. His private practice in Paris, France has built up a reputation for the quality of services provided. Recently Dr Goumot acquired a top-of-the range display monitor, Coronis Uniti from Barco. We wanted to find out more about the practice in general and the new monitor in particular so we had a conversation with Dr Goumot.

Q. As a start please tell us about your practice.

Of course, but first let me first introduce myself and give you an idea of my background.

I have been practising medicine since 1971 and received my training in mammography from Prof André Willemin — in France, Prof Willemin’s unit was for a long time considered as the reference center for mammography. I spent 20 years with Prof Willemin, first as assistant and ultimately as his partner. And among the many things that I learned from him was the importance of the physician having the maximum direct contact with the mammography patient at all times which is a principle that we still follow in my practice today. So, today, I encourage my staff not to read mammography images without first spoken directly to the patient, established her clinical history and having clinically examined her.

I am happy to say that all the clinicians who have received their training in our practice, many of whom have gone on to become heads of radiology or mammography departments, throughout France and even as far away as Canada, still retain our philosophy of having maximum medical contact with the patient. They are radiologists/physicians rather than pure radiologists.

But let’s get back to the practice itself. I founded it in 1991 and nowadays we see approximately 9000 patients per year.

These are all symptomatic patients or asymptomatic patients who have an increased predisposition to the development of breast cancer, such as family history. Whatever — all our patients need, and receive, an in-depth diagnostic work-up.

So the profile of our patient population is quite different from that seen in screening mammography, which we don’t do in our practice.

We have three examination rooms, in which we see, from 8.00 am till 7.00 pm every day, between 35 and 45 patients. To handle this workload I have a total of 11 colleagues, including radiologists, nurses and receptionists operating in two teams.

But it doesn’t matter which of my colleagues actually sees the patients — the procedure is always the same. First the establishment of the clinical history, then physical examination including palpation followed by an ultrasound examination. For the ultrasound scan, we have three Aplio MX systems from Toshiba with high resolution 18 MHz transducers and color Doppler.

Q. And what about mammography?

For mammography, we are totally digital with two Amulet digital mammography systems from Fuji both of which have a resolution of 50 microns (one in 3D). In addition we have one Amulet Innovality system from Fuji which allows us to carry out breast tomosynthesis, which is our flagship imaging modality.

Regarding reading of the images we actually have a three reader system, the first of which is me, then a colleague as second reader and finally Computer-Assisted Diagnosis.

Don’t forget that our patient population is skewed with a high percentage of high risk cases or those already diagnosed.

Q. Let’s now get to the monitors

Yes, there is no point in having very high technology in the imaging systems that we use, if the monitors don’t faithfully reproduce the image.

For the last fifteen years we have only had Barco monitors in our practice and as the technology progresses we have upgraded our monitors to take advantage of the advances. For seven months now we have had the latest top-of-the range monitor from Barco, the Coronis Uniti 12 MP and are really delighted with it. We use it for all FFDM tomosynthesis and multimodality imaging. It is hooked up to our PACS system and its large screen enables us to compare prior and current images It is the combination of the high spatial resolution and screen brightness that we appreciate most, together with the ergonomic ease-of-use, None of our radiologists complains about eye-strain.

For the moment we only have one Coronis Uniti 12 MP monitor, but as our other monitors come up for replacement we plan to replace them with the 12MP Coronis Uniti.

Dr Goumot has had the Coronis Uniti display for seven months.
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New tomosynthesis applications enhance clinical versatility

Tomosynthesis is an X-ray imaging technology which has been proven to facilitate more accurate diagnoses. Current state-of-the-art tomosynthesis technology uses only a low X-ray dose and is simple and rapid to carry out but nevertheless provides high quality multi-slice images enabling the examination of anatomic structures which otherwise may be difficult to visualize with conventional radiography. These characteristics account for the recent growth in interest in the technology.

Already a pioneer in the development of tomosynthesis for RF with its Sonialvision system which has been on the market for 10 years, Shimadzu has just released the 4th generation of the series – the Sonialvision G4 — which incorporates several new application features including the latest advances in tomosynthesis. The technological approach that is used involves the fusion of cone-beam CT reconstruction with digital image processing to produce images of specified cross-section from a single tomography scan.

**HIGH DEFINITION TOMOSYNTHESIS**

With its multiple slices tomosynthesis can produce huge amounts of data. To reduce processing time and to rapidly display the final images on the monitor, the new system acquires data using a 2x2 binning process. With Shimadzu’s latest imaging technology, the new “High Definition Tomosynthesis” system enables the reconstruction of the tomosynthesis image from original images acquired in the 1×1 high definition mode using a 6-inch field-of-view. This new mode generates tomosynthesis images with even higher spatial resolution and is particularly suited to the detailed examination of areas such as the bones of the finger tips or wherever even very small micro-fractures are suspected [Fig 2].

**MULTIPLE POSITION TOMOGRAPHY**

The Sonialvision system allows images to be recorded at any angle needed for the particular examination — at a variety of table angles, or with the patient in the upright standing position or in a reverse inclined position, which is not possible with conventional CT scanners. This helps expand the examination possibilities, for example to examine joints under weight-bearing conditions. [Fig.1]

**LOW-DOSE TOMOSYNTHESIS**

By switching the field-of-view and using collimation, X-ray exposure can be reduced to a minimum so preventing unnecessary radiation exposure outside the area of interest. A new “Low-dose Tomosynthesis” mode is now available to reduce dose levels even further, which is a significant advantage in pediatrics.

**OBlique toMOsynTHESIS**

This feature provides oblique tomographic images reconstructed at any optimal angle up to ±20 degrees laterally or vertically to enable the optimal angle and is useful in the examination of the spine, hip joints and other areas which could be difficult to analyze using standard horizontal tomographic images parallel to the table-top.

**ACQUISITION TIME**

Since the images of a specific cross-section are reconstructed from a single low-dose tomography scan motion, multiple-slice image acquisition in the new system actually needs less time and lower X-ray dose than conventional linear tomography. The short examination time is very helpful when dealing with stressed or immobile patients.

**METAL ARTEFACTS**

Another key clinical benefit of tomosynthesis is the minimum interference by metal artefacts; such interference is regularly seen on conventional CT. This feature is of particular value in the examination of patients with metal implants. [Fig 3]. The combination of all the above features has already evoked high interest on the part of many Sonialvision G4 users throughout the world.

SHIMADZU EUROPA, 
DUISBURG, GERMANY, 
www.shimadzu-medical.eu

![Figure 1](image1.jpg)

*FIGURE 1. The Sonialvision G4 system allows acquisition of images under weight-bearing conditions which is particularly valuable in orthopedics.*

![Figure 2](image2.jpg)

*FIGURE 2. HD tomosynthesis*

![Figure 3](image3.jpg)

*FIGURE 3. There is only minimal interference from metal artefacts, making the system ideal for orthopedic patients with metal implants.*
UPDATE
TECHNOLOGY

Powerful yet easy-to-use ultrasound system

Providing excellent image quality, SonoScape’s newly released S50 ultrasound system incorporates a comprehensive, upgraded platform, making it a truly epoch-making ultrasound system. Equipped with powerful single crystal transducers and remarkable 4D functions the system also features an intelligent workflow organization, designed to meet a wide variety of general imaging needs. In addition to the efficient workflow the system provides excellent human-machine interaction and user defined settings.

With its advanced software and hardware, the S50 has a perfectly balanced design, both from the internal and external points of view. The system provides various imaging software packages suitable for various applications such as cardiology, radiology, OB/GYN, etc. With advanced features including cardiac and 4D packages, the S50 was designed to meet the extensive clinical challenges not just of today but also of tomorrow.

The S50 is configured with a new imaging engine, which can significantly enhance imaging performance speed and convenience, especially for 3D/4D imaging. Outstanding volume performance dramatically enhances diagnostic confidence.

The new system includes several features such as:
- Inversion 4D which provides a more in-depth evaluation of vascular and cystic structures creating a three-dimensional cast-like volume of the anatomy of the area of interest.
- S-Live, which allows detailed visualization of subtle anatomical features, thereby enabling intuitive diagnosis with real-time 3D images.
- S-Depth, which can automatically display the near-far relation from transducer to target, represented by a smart designed color coding. It can help operators to judge the spatial relationship on real-time 3D images.
- C-Xlasto elastography. Differences in tissue responses are detected and visualized in real-time by special elastography algorithms which display results in graphical representations.

SONOSCAPE,
SHENZHEN, CHINA
www.sonoscape.com

“Go-anywhere” X-ray system

Developed entirely by the company OR Technology, the fully digital Amadeo M mini X-ray system incorporates a sophisticated design which reduces components to only the essential, functional operating elements. The new system is therefore particularly suitable for portable use, being easily transported thanks to its low weight (only 68 kg) and compact build. Its portability is especially useful wherever it is not possible to transfer patients to a hospital or medical center for diagnostic radiology. Application fields of the new system are first aid services, home care, nursing homes, medically oriented aid organizations, military purposes and ships or oil rigs. The lightweight system can easily be dragged up and down steps and obstacles and can be swiveled in all directions — a big advantage in confined spaces. It is stable and does not tip over on uneven terrain. Its large, sturdy wheels permit effortless movement.

The system includes all necessary components for a functional system, including X-ray detector, X-ray generator and image processing workstation. The latter is delivered with a globally proven software package which includes a convenient X-ray positioning guide for fine adjustment.

A special promotional video clip has been produced describing the new system and can be visualized on YouTube.

OR TECHNOLOGY
ROSTOCK, GERMANY
www.or-technology.com
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Chinese entry into the European market with new PET/CT system

The China-based company Neusoft Medical Systems has just launched its NeuSight PET/CT system on to global markets. The PET/CT system is CE certified & US FDA approved and combines leading-edge technologies and innovations to create super-fine and low dose high quality images, which provide more accurate diagnostic information. The new instrument is an example of the company’s determination to enter into the international high-end PET/CT markets chiefly through innovative technology.

Previously, Neusoft Medical Systems had a technical collaboration with Positron, a USA cardiac PET company located in the USA. Now, Positron is fully owned by Neusoft, and has more than 20 PET installations in the USA alone. The new NeuSight PET/CT system was through a combination of the technological know-how of both Neusoft & Positron. The R&D process for the new scanner began in 2012 finishing with four PET/CT prototypes passing factory verification in 2014. In 2015, NeuSight PET/CT passed CE certification and was approved by the US FDA.

The NeuSight PET/CT is equipped with high-end electronics that offer high quality diagnostic images with fastest acquisition and post processing speeds, thereby providing radiologists/nuclear medicine specialists with high throughput and a positive return on investment, as well as maintaining a dedication to keeping patient safety the top priority.

Founded in 1998 and with software development as its core competency, Neusoft Medical Systems has become China’s market leader in medical equipment and service. Mr. Patrick Wu, CEO said, “As a leading medical equipment provider, Neusoft Medical Systems puts software technology as our core competency. We have been continuously introducing software and product engineering innovations to the Chinese medical industry for more than 20 years. The launch of NeuSight PET/CT is a new breakthrough for Neusoft in high-end medical equipment.

Looking forward, we will focus our efforts in innovation and operational excellence to offer high-quality medical products and services worldwide.”

As a core modality in molecular imaging, PET/CT has the potential to provide a variety of valuable functional imaging data for example in metabolite and neurology receptor studies, with the information being enhanced with anatomic information generated by CT.

The NeuSight PET/CT provides such combined anatomic and functional imaging using qualified design and technologies and provides multiple molecular imaging functions for tumor, brain and cardiac scanning. The scanner has a large port and dual pillar bed to improve patient comfort and scanning experience. Optimized data collection technology improves scan speed and analytical accuracy. The platform uses an advanced workstation, data management and analysis system.

Other features are:

- A 72 cm gantry for increased patient comfort and reduced anxiety
- CT extended FOV: CT provides a 70 cm transaxial view
- A patented double lifter system eliminates any deflection between CT and PET during imaging thereby facilitating precise fusion of PET-CT Images.
- 21:9 oversized curved display, creating a comfortable visual experience with crossover innovation, widescreen acquisition, free switching and one-key workflow for automatic quantitative analysis.

The NeuSight PET/CT thus provides patients with maximum comfort for the whole spectrum of acquisition modes, from the simplest study to the longest dynamic acquisition. The addition of visual & vital-signs real-time patient monitoring optimizes the patient experience and enhances the likelihood of positive patient outcomes.

NEUSOFT
SHENYANG, CHINA
www.neusoft.com
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Late registration 31 October 2016

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www.escardio.org/EACVI
The two recently introduced ultrasound systems from Siemens — the Acuson NX3 and AcusonNX3 Elite — have been designed specifically around the way clinicians work. Both mid-range systems offer a simple, intuitive interface combined with innovative imaging solutions for examinations primarily in general medicine, obstetrics/gynecology, pediatrics and neurology.

The NX3 model features a new way of scanning with three times more customizable keys and a faster workflow with 28% fewer keystrokes as determined in comparative studies. The customizable control panel and touch screen combined with Siemens innovative workflow make it possible to perform certain routine anatomical measurements faster than traditional solutions.

Both new systems are equipped with a 21.5 inch (55cm) LED monitor and a 10.4 (26 cm) inch touch screen, which are among the largest in their class and improve the time to report. To make daily routine examinations easier, the new systems feature advanced ultrasound innovations from Siemens, including Clarify Vascular Enhancement technology. This exclusive technology provides multiple levels of clarification to optimize tissue contrast resolution and definition of both tissue and vessel walls.

Higher image resolution is enabled with a 16 MHz transducer, which is especially suitable for breast and musculoskeletal imaging. Another exclusive solution is the 220-degree endocavity transducer, which offers up to a 75 percent larger field of view than standard probes.

Susan Black, Program Director and Senior Sonographer at Mercy Medical Center, in Canton, Ohio, USA, noted that the new system was easy to learn. “The Acuson NX3 from Siemens is easy to use, easy to learn, and this helps when I’m training staff because I don’t have to spend a lot of time teaching them how to use the system. We can get patients in and out a lot quicker, and it helps us to be more efficient.”

SIEMENS HEALTHCARE ERLANGEN, GERMANY www.siemens.com

**Speed and flexibility in interventional procedures**

With Toshiba’s new INFINIX-i Rite Edition system, equipped with a high-speed C-arm, it is not the patient that moves but the hardware, smoothly sliding from a parked position to any targeted anatomical region. With a sliding movement of 210 degrees, the INFINIX-i Rite Edition rotates with a speed of 80 degrees per second, minimizing motion artefacts and delivering unmatched 3D image quality while reducing the use of contrast media. Thus, the ceiling-suspended C-arm moves around the patient giving the clinician fast peripheral access. The arm rotates in any direction with the detector and the beam collimator being synchronized. The image is automatically shown heads up on the clinical display, no matter what angulation is required for image acquisition. As interventional procedures become more complex, advanced 3D acquisition is important to meet this requirement the INFINIX-i Rite Edition opens up new horizons in 3D imaging.

If need be, the new system can be moved out of the way during a procedure thanks to the unique C-arm movement. During lung biopsies the C-arm can be flipped 180 degrees to place the flat panel detector beneath the patient table.

TOSHIBA ZOETERMEER, THE NETHERLANDS www.toshiba-medical.eu
Radiation dose monitoring software

DoseWatch is a web-based patient radiation dose monitoring software from GE Healthcare that is used to capture, track and report radiation dose directly from any imaging device or PACS. DoseWatch is multi-modality and vendor agnostic. The system helps radiologists deliver the right dose, while still producing diagnostic quality images. By tracking patients’ cumulative dose over time, excessive medical radiation exposure can be avoided. Cumulative dose tracking can be carried out across health systems to assess radiation dose delivered to patients undergoing a variety of imaging procedures. Radiation dose data can be monitored across all modalities, regardless of manufacturer.

Dose outliers. There is an alert notification system when dose levels exceed predefined thresholds. Dose comparison analyses compare study dose metrics for all modalities, stratifying by site, device, study description, period and patient age range. Performances can be compared to national and local Diagnostic Reference Levels (DRLs).

The software includes a variety of embedded analysis and optimization capabilities, including: the capture of acquisition information and dose indices, providing visibility for each interventional and cardiovascular procedure. The review function allows users to understand how the dosimetrist performed each exam.

GE HEALTHCARE
CHALFONT ST. GILES, UK
www3.gehealthcare.com

Ultrasound system for clear diagnostics at point-of-care

Specialists in developing cutting-edge ultrasound solutions and providing world-leading education to enable point-of-care visualization access, FUJIFILM SonoSite Inc., have just announced CE mark approval and 510(k) clearance for its new portable ultrasound system, the SonoSite Edge II. Designed with emergency medicine and critical care applications in mind, the Edge II features revolutionary transducer technology that delivers a better imaging experience for the most rugged environments.

“Since SonoSite introduced the first portable ultrasound system in 1999, it has continued to build solutions that anticipate the bedside provider’s needs,” said Dr D Mandavia, chief medical officer and senior vice president, FUJIFILM SonoSite Inc. “The Edge II ultrasound system stays true to the SonoSite tradition of durability, reliability, and ease of use. However, we have also incorporated enhancements to accelerate the time to image acquisition, enabling clinicians to make more confident decisions and focus on what matters most, the patient.”

In the acute care environment, reducing the time to make an accurate diagnosis is a critical need. The Edge II features DirectClear technology, a novel, patented process that is available on select transducers. DirectClear elevates transducer performance by increasing penetration and contrast resolution. This transducer innovation, combined with a new wide-angle display that offers a 33% increase in viewing angles, contributes to an unsurpassed imaging experience for the bedside clinician.

Designed to be truly portable and used in the most rugged environments, the Edge II reinforces FUJIFILM SonoSite’s commitment to reliability and durability with the company’s Armored Cable Technology. With an embedded metal jacket, armored cables protect transducers from common abuse accident scenarios, like being rolled over, stepped on, or twisted, and help maintain image quality over the life of transducers built on the cable platform.

With these technology innovations, an optimized design to enhance infection control management and efficient use of common controls such as gain, the Edge II is the rugged, reliable, and responsive ultrasound solution for point-of-care.

FUJIFILM,
TOKYO, JAPAN
www.sonosite.com

Simplifying the scanning of patients with MR Conditional implants

Philips has introduced ScanWise Implant, the industry’s first MRI guided user interface and automatic scan parameter selection to help simplify the scanning of patients with MR Conditional implants, such as knee and hip replacements, spine implants and pacemakers. The new software helps users streamline exams and supports diagnostic confidence of this growing patient population. ScanWise Implant adds to Philips’ suite of diagnostic imaging solutions designed to support healthcare professionals’ first-time-right imaging, helping to improve hospital workflow, diagnostic confidence and, ultimately, patient experience.

MRI is the modality of choice for diagnosing conditions such as neurological disorders, cancer, and muscle,
joint and back pain. These conditions are most prevalent in older patient populations. The population with large joint replacements and implanted cardiac devices is expected to increase by about 70 percent over the next five years. However, implants can create a number of challenges with MRI exams. For example, it's difficult for clinicians to understand and scan within the safety limits defined by each implant manufacturer. These limits are not always clear or easy to implement on the MR scanner, causing patients with MR Conditional implants to often be denied MRI exams. In fact, every year 300,000 patients in the U.S. are denied access to MRIs because of a cardiac implantable electronic device.

“We saw an opportunity to use our advanced digital health technology to help make MRIs more accessible to a patient population routinely denied access to this modality,” said Robert Cascella, Executive Vice President and CEO, Philips Imaging. “At Philips, we strive to arm clinicians with innovative technology, so all patients can receive the most confident diagnosis and best treatment plans. By integrating patients, practitioners, and process with technology, we're helping radiology transform its care practice.”

Introducing MRI to a patient’s diagnostic and treatment plan allows clinicians enhanced accuracy and improved workflow, and provides patients with access to better care. According to Dr H Kugel, of the Department of Clinical Radiology, University of Münster, Germany. “The previous industry standard was: if patients had an implant, they couldn’t be examined with MR. However, patients deserve the best imaging modality available and shouldn’t be excluded from a modality, because risks aren’t truly known and documented. It’s a milestone achievement that Philips developed an answer for patients with conditional implants to have access to MRIs.”

“From a technologist’s perspective, we’re excited about the prospect of shortening exam times and broadening the diagnostic modalities available for those patients with MR Conditional implants,” said Scott Hipko, Chief MRI Research Technologist, The University of Vermont, College of Medicine. “Philips understands the needs of radiologists and brings the expertise needed to create a smart solution to help guide operators to meet the specific criteria for each implant.”

PHILIPS HEALTHCARE
EINDHOVEN, THE NETHERLANDS
www.philips.com

3D C-arm with flat-panel technology

The revolutionary Ziehm vision RFD 3D has been specifically developed for high-end 3D procedures in orthopedics, trauma and spinal applications. Using Ziehm’s ground-breaking technology, smartscan, it is possible to generate a complete 3D cubical dataset with 16 cm edge length, while keeping the design of a conventional C-arm, and the advantages of a variable isocenter.

The Ziehm vision RFD 3D is the first mobile C-arm on the market that works with 30 cm x 30 cm flat-panel technology and provides this level of outstanding 2D imaging as well as the complete 3D information during clinical interventions.

Ziehm Vision RFD 3D is the new Ziehm Imaging flagship product and combines 2D and 3D functionality to offer full intraoperative control in high-end applications in orthopedics, traumatology and spine surgery.

With its 30 cm by 30 cm flat-panel and up to 7 cervical vertebrae in one scan volume, this mobile C-arm offers the largest 3D image volume on the market.

Ziehm Imaging has more than 10 years of experience in 3D imaging solutions. The company’s C-arms offer 2D and 3D functionality in one device enabling comprehensive, intraoperative control that reduces the need for post-operative CT. This makes it possible to raise quality levels and gives peace of mind even in demanding procedures. Rates of cost-intensive revisions can be reduced significantly and surgeons and hospitals can benefit from better surgical outcomes and therefore a larger number of satisfied patients.

ZIEHM IMAGING
NUREMBERG, GERMANY
www.Ziehm.com

Optimized fluoroscopy/radiology system

Fluoroscopy technology has been optimized specifically for large and mid-size hospitals and medical centers with the new CARESTREAM DRX-Excel Plus System. It combines both fluoroscopy and general radiology capabilities in one compact unit. It also delivers accelerated workflow, high-resolution images and a wide range of exams.

The system can perform contrast exams using fluoroscopy that can be associated with a radiography image, in addition to specialising procedures that record both fluoroscopy and radiography sequences. The new system offers a source-to-image detector distance of 180 cm, an ergonomic design and an elevating table.
that tilts and can be lowered or raised to provide flexible, comfortable imaging experience for patients. The system can perform contrast exams using fluoroscopy that can be associated with a radiography image, in addition to specialised contrast procedures that record both fluoroscopy and radiography sequences and interventional procedures. Several configurations are available: a conventional configuration, utilizing film or CR cassettes or the company’s wireless DRX-Detector for radiology and an image intensifier for the fluoroscopy exam, or an integrated flat panel detector produces high-resolution images for general radiography as well as fluoroscopic sequences. Carestream enables its DRX detector to be shared with any of its DRX portfolio of imaging systems including R/F systems.

**US approval for Breast Tomosynthesis on Multi-Modality Monitor**

The EIZO Corporation has recently announced that it has received FDA 510(k) clearance for breast tomosynthesis from the U.S. Food and Drug Administration for its 8 megapixel multi-modality monitor, the RadiForce RX850.

When used in combination with digital mammography, tomosynthesis provides radiologists with multiple screening techniques that can be utilized together for increased diagnostic precision in breast cancer detection. With FDA 510(k) clearance for the RadiForce RX850 in tomosynthesis, mammography, and general radiography, EIZO continues to provide a high degree of customer assurance to medical breast screening professionals and their patients.

The RadiForce RX850’s super high-resolution screen (4096 x 2160) displays 8 megapixels of information with a pixel pitch of 0.1704 mm for viewing medical breast images in exceptional detail. To detect the smallest structures, the monitor offers a high contrast ratio of 1450:1. The deeper black levels distinguish similar shades of gray for sharper monochrome image reproduction. The RadiForce RX850 is “Changing the Workstation Paradigm” by offering a truly multi-modality monitor capable of displaying various color and monochrome imaging modalities on one screen. When efficiency is important, viewing mammography specific and PACS software applications on the same screen keeps radiologists from having to wander the halls to their next read.

**Clinical Portal: providing information for all care providers, inside and outside the hospital.**

Agfa HealthCare’s Clinical Portal, offers a gateway to integrated care and provides a patient-centric overview of patient information from various sources, to the stakeholders in the patient’s care, inside or outside the hospital. Easy to integrate and to use, it provides a comprehensive road map running from the Portal itself, through to true integrated care and the electronic health record (EHR).

Agfa HealthCare also has a unified Enterprise Imaging for Radiology platform, which supports value-based care coordination with a broad range of functions that align the enterprise by facilitating quality outcomes. This completely unified Enterprise Imaging platform takes a whole new approach to imaging management, providing a picture archiving and communication system (PACS), reporting, advanced image processing and integration of clinical information – all in one, sophisticated platform. Hospitals and users no longer need to deal with a separate radiology PACS, separate cardiology PACS, separate vendor-neutral archive (VNA), separate viewer: they can grow the Enterprise Imaging platform from various “-ologies” (such as radiology or cardiology), to make all images, available to all involved caregivers. Enterprise Imaging Business Intelligence allows easy access to a wealth of information in the form of reports and tools that provide historical, current and predictive views of operations.

The Enterprise Imaging for Radiology and MUSICA platforms both support Agfa HealthCare’s commitment to the ALARA principle: keeping patient radiation doses ‘As Low As Reasonably Achievable’.
Satellite Symposium jointly organised by Bayer and Bracco

Improving the risk-benefit ratio of CT and MRI procedures

Objective
Goal of this event is to:
- Strengthen the understanding of benefit deriving from contrast enhancement in MRI and CT procedures.
- Improve knowledge on how to most effectively prevent and manage immediate-type adverse reactions to MRI and CT contrast agents.

Program
Chairperson: Christian Herold

Session 1
When to use contrast to enhance diagnostic performance in CT and MRI
- Contrast enhancement needs in abdominal imaging - Luis Marti-Bonmati
- CT and MR contrast in brain imaging – Paul Parizel

Session 2
How to effectively prevent and manage acute adverse reactions to MR or CT contrast
- Size of the problem in 2016 – Fulvio Stacul
- What to do before a contrast-enhanced exam – Aart van der Molen
- What to do during and after the exam – Fulvio Stacul

Faculty:
Christian Herold
Vienna General Hospital – Wien, Austria

Paul Parizel
Antwerp University Hospital (UZA), University of Antwerp (UA) – Edegem, Belgium

Luis Marti-Bonmati
Pohet University Hospital – Valencia, Spain

Aart van der Molen
Leiden University Medical Center – Leiden, The Netherlands

Fulvio Stacul
Cattinara Hospital – Trieste, Italy
The NEC MDT Room Solution is a complete solution including everything needed to provide the latest medical meeting room infrastructure. The Medical Desktop and Large Format Display – both 8MP – can be cloned on a pixel to pixel level to provide outstanding image quality without any loss of data or visual detail. This solution helps to establish efficient reviewing processes and diagnostic investigations as well as providing hospitals a future-proof investment in state of the art technology and quality.

www.medical.nec-display-solutions.com