

EXPRESS RADIOLOGY

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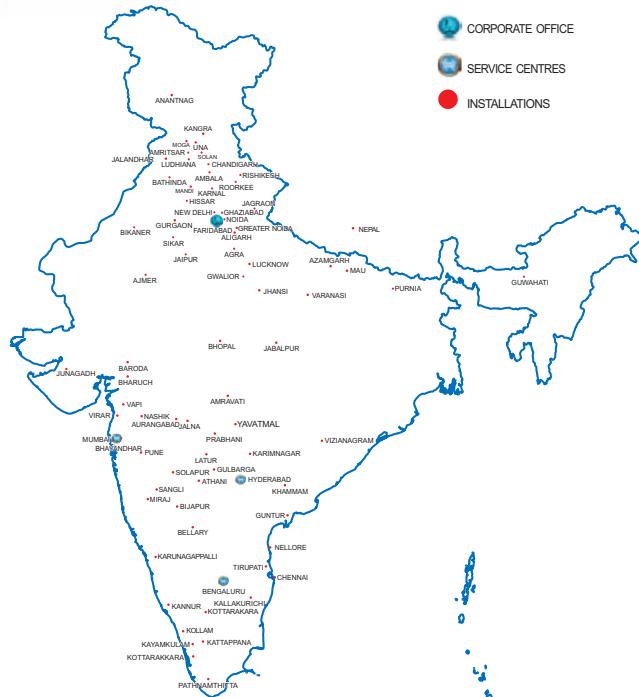
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JANUARY 2020



ADVANCES IN
CR AND DR
TECHNOLOGIES
IN INDIA

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ESTABLISHING
A RESEARCH
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PROGRESS?

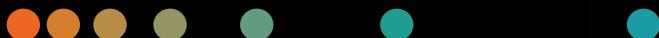
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EDITOR'S NOTE

EXPRESS RADIOLOGY | JANUARY 2020



VIVEKA ROYCHOWDHURY, EDITOR
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Resolutions for the decade ahead

What should India's radiology community and medical imaging companies aim at achieving in the decade ahead? Here are a few ideas that could be discussed at the 73rd Annual Conference of the Indian Radiological & Imaging Association (IRIA), scheduled from January 23-26 at Gandhinagar, Gujarat.

Firstly, radiologists could resolve to dedicate some time and expertise to advance public health in India. And the government's Ayushman Bharat (AB) scheme gives them ample opportunity to do so. For instance, it was reported that a single hospital in Chhattisgarh, the government-run Dr Bhimrao Ambedkar hospital, averaged more than 30 MRI scans and 50 CT scans per day. These vital diagnostic tests can now be accessible beyond India's Tier I and II towns to Bharat's Tier III and IV towns, thanks to subsidised rates for AB card holders. But making this a reality requires both imaging infrastructure and trained manpower. Will qualified radiologists partner with AB to share their expertise? There are many who are already doing so through telemedicine initiatives but their tribe needs to increase exponentially to really make a difference.

Secondly, will the government

resolve to meet industry half way? The Government of India does recognise how vital the medical devices segment and within it, the imaging segment is. The incentives set in place from the launch of the Make in India initiative in 2015 could start showing results in the decade ahead as medical device parks in Andhra Pradesh, Telangana, Tamil Nadu and Kerala start becoming operational. But can the government speed up the approval process?

Thirdly, can corporates resolve to make more meaningful contributions? Philanthropic trusts are taking up the challenge of designing medical imaging equipment tailored for India's needs. For instance, the Tata Trust is said to be backing the development of India's first Made in India portable MRI, clearly designed to take the MRI into rural under-served areas. Again, corporates need to multiply this effort at least five times to reach a tipping point.

Fourthly, will the imaging industry step up to the challenge to make more affordable equipment? Let us not forget that India is heavily dependent on imports for high end medical imaging equipment. India imports nearly 75 per cent of the country's medical devices, particularly higher end products including medical

imaging, and ultrasonic scans. Which is why it has been designated as a preferable export sector by the US government, as the trade barriers are considered to be lower.

India and the Asia Pacific market are set to be growth drivers for the imaging market for the next few years. The diagnostic imaging market is set to grow at a CAGR of 6.1 per cent from 2019 – 2024, according to a report from Mordor Intelligence. While Asia Pacific is the fastest growing market, North America is by far the largest market though it has matured and the growth rate is slowing.

A Research and Markets report projects a similar CAGR of 5.1 per cent for the diagnostic imaging services market to reach \$693.4 billion by 2024. X-rays accounted for the largest share of the diagnostic imaging services market in 2018 while neurology accounted for the largest share of the MRI services market in 2018.

While these statistics reassure us that India as a market for medical imaging will remain attractive, one hopes that IRIA 2020 will also focus on the social need to Make in India, for Bharat and the world, as well as for qualified radiologists to share their skills with the most vulnerable of patients.

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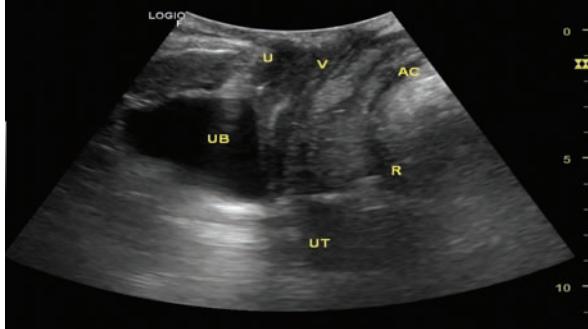
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Simulation, virtual reality are future of radiology education

Advancing technology continues to move the needle in radiology classroom, says an RSNA report

As healthcare continues to evolve at a rapid pace, radiology must keep up — or stay ahead of the curve — in many areas, including education. But is the speciality doing enough to prepare medical students for the future of radiology?

The answer, according to Harprit Bedi, Neuroradiologist and Associate Professor of Radiology, Boston University School of Medicine, rests with radiologists' willingness to adopt the technology that is already revolutionising healthcare education.

"So much of residency is about memorising for exams, but with technology, there's less of a need to remember — you can just Google it," said Dr Bedi, who has published and lectured on incorporating technology in residency training programmes. "How does that focus on recall help radiologists take better care of patients? I'm not sure that it does."

According to Dr Bedi, who is presenting sessions on technology-driven education at RSNA 2019 (see call-out box below), achieving excellence in radiology requires two core skills. First, students must be able to perceive the abnormality and interpret what they see. But this is



only the first step.

"Students also need critical thinking, or the confidence to analyse and synthesise everything they know and be able to communicate this as an evidence-based management plan," he said. "This is the key to providing excellence in patient care, and this is what our teaching should work toward."

Luckily, technology, and in particular, simulation and virtual reality (VR), is moving radiology education in that direction.

Connecting the dots with simulation

Simulation comprises a wide variety of computer-based and model-based

programmes and exercises designed specifically to standardise the education of medical students.

Simulation is also a great way to teach critical thinking and prepare residents to be independent readers, according to researcher Lonie Salkowski, Professor of Radiology, University of Wisconsin – Madison School of Medicine and Public Health.

"The technique allows putting a learner in a situation they are not familiar with and test how they apply their knowledge to near real-world situations," Dr Salkowski said. "It's a very effective method for testing preparedness and building confidence without risking patient care."

Dr Salkowski's interest in simulation began while teaching radiology and anatomy classes. "In these classes, I noticed that students tended to understand anatomy in dissection and when presented with medical images, but that they struggled to put the two together," she said.

She delved into that issue in her research project, "Investigation of radiology-based three-dimensional simulation to explore attributes of novice and expert learners in their process of correlating and sense-making of medical images with the human body," funded by a 2018 RSNA Education Scholar Grant.

To develop instructional clinical scenarios, Dr Salkowski created an integrated imaging and 3D simulation device that combines the physical resemblance of a body with abdominal CT scans. Students viewed the anatomical CT slices and were then asked to localise the position of anatomy seen on the CT images on the physical surface of the body.

This exercise highlighted the struggle many students experience when transferring knowledge from one domain to another, Dr Salkowski said. "However, students have the foundational knowledge that we as educators can use to help them make this integration," she said. "This is a critical thinking skill that our curriculum needs to work on, and one that simulation is well-positioned to help with."

An immersive learning experience

Simulation can be enhanced using virtual reality (VR) and augmented

SIMULATION COMPRISSES A WIDE VARIETY OF COMPUTER-BASED AND MODEL-BASED PROGRAMMES AND EXERCISES DESIGNED SPECIFICALLY TO STANDARDISE THE EDUCATION OF MEDICAL STUDENTS. IT IS ALSO A GREAT WAY TO TEACH CRITICAL THINKING AND PREPARE RESIDENTS TO BE INDEPENDENT READERS

reality (AR), according to one expert who is using the technology in his classroom.

"Today, residents come in, rotate, and at some point, are put into the room with a patient and are expected to perform image guided procedures at an advanced level," said Raul Uppot, Interventional Radiologist, Massachusetts General Hospital and Assistant Professor of Radiology, Harvard Medical School, Boston. "With technology like virtual reality, we can build a student's confidence and move toward mastery by providing a 'hands-on' experience without involving a patient."

Dr Uppot began exploring how to apply different technologies coming out of the gaming and entertainment

industry to radiology education. He found that VR systems were particularly well suited for teaching because they involve total immersion.

Using head-mounted 360-degree cameras, Dr Uppot and colleagues began recording their radiology environment – from the equipment around the rooms to the actual procedures.

"Wearing VR headsets, trainees are instantly immersed in the IR room, where they can look around and see not only the procedure but also the equipment, the nurse, the technologist – everything and everyone," said Dr Uppot.

Because it is not financially practical to purchase high-end, commercially available VR headsets for every student, Dr Uppot developed a more affordable method for bringing this immersive experience into the classroom.

Students need only to download an app onto their smartphones to access a pre-recorded video of the interventional radiology room. They then clip a plastic stereoscopic device directly to their smartphone, which creates a stereoscopic view.

Innovations like this represent the future of radiology education, he said. "With the right technology, we can move beyond rote learning and achieve meaningful learning, which is an essential building block of critical thinking," added Dr Uppot.

Dr Bedi echoes that sentiment, "As we see with virtual reality and other immersive devices, the technology is out there, we just need to master how to best leverage it to help us achieve excellence."

Sonobuzz held in Mumbai

The first edition of Sonobuzz - The Ultrasound Festival was held at Hyatt Regency, Mumbai from December 13-15, 2019

Advancements in ultrasound technologies have led the modality to become the preferred tool for imaging during interventional radiology (IR) procedures. To explore the various applications and techniques in ultrasound that can be utilised for the diagnosis and treatment of complex diseases, ultrasound experts organised the first edition of Sonobuzz in Mumbai.

The event focussed on engaging in knowledge sharing activities and educational sessions. More than 600 delegates comprising of radiologists and radiology students, and around 100 trade delegates from various companies took part in this mega event.

The programme included Practical Tips on Day 1, Fetal Echo by Dr Mark Sklansky, Day 2 on Doppler & Fetal Anomalies and on Day 3, with star speakers such as Dr Amar Bhide, Dr Alpana Joshi, Dr Nitin Chaubal, Dr BS Ramamurthy, Dr Ashok Khurana, Dr Chander Lulla and Dr Bijoy Balakrishnan amongst others.

The highlight of the educational session was Dr Mark Sklansky's simplified Fetal Echo lectures. His insights were a boon to all who attended the event and most delegates were left asking for more by the end of the day. There also some interesting sessions that discussed the use of ultrasound in tissue diagnostics.

The event also included some entertainment by Raju Srivastava and a



DJ Nite with DJ Stetson.

The organisers also announced the next Sonobuzz event which will be held in November 2020. The highlight for the next year will be feature lectures by Dr Stephanie Wilson and Dr Thomas Winter amongst other speakers.

Take a glance at the happenings of Sonobuzz 2019.



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ADVANCES IN **CR AND DR** TECHNOLOGIES IN INDIA

“We have a strong financial foundation, innovative technology and a well deserved reputation”

Carestream India has had an extremely rewarding year in 2019. In the new year, the company is all set to launch some new innovations.

Vincent Chan, President- Asia Pacific, Carestream Health speaks to Express Healthcare on their future plans

How was the year 2019 for Carestream India?

2019 was a fantastic year for Carestream. We are proud to share that we have grown in all our key product segments and in all our key markets, including India. In addition to growing our business, we also achieved various milestones in India:

- We established our 24x7 Global Business Operations Centre (BoC) in Mumbai. India with its exceptional talent, leadership and business infrastructure will support both the front and back office operations of Carestream across the world.
- We also launched a Cloud based Service Operating Platform which will help improve our service delivery and also improve our customer centricity. This was one of the biggest service transformation projects in Carestream with an end to end service management solution.
- Our India Logistics team received an internal certification of a Silver Quality Advocate Centre. This recognition was achieved by



effectively using eight Quality Advocate tools for driving continuous improvement and perfect order fulfilment and delivery, as part of our regular operations.

► We also had great success on the development of our employees through various programmes such six sigma belt certifications and the top talent club.

The changes we made in 2019 in our business and our achievements above, position Carestream to continue serving a broad range of healthcare providers, and our global sales, service and support teams are experts in helping customers deliver quality care, control costs and maximise return on investment.

Carestream India has earned the certification of a "Great Place to work" and "The Most Trusted Healthcare Brand". Could you please elaborate on these certifications?

Carestream Health India has been re-certified as a Great Place to Work, based on a rigorous assessment conducted by the global research and consulting firm, Great Place to Work Institute. This is the organisation's third consecutive certification. I believe that a great workplace culture means a high-trust, high-performance culture and this certification is a validation that our employees trust the people they work for and take pride in what they do. We are extremely proud to be certified once again and will continue our drive towards excellence.

We also received India's "Most Trusted Healthcare Brand" Award which was presented by White Page India, on September 21, 2019 at the Best Of India Conclave held at Hotel

Four Seasons, Mumbai. Most Trusted Brands is an inspiring media platform that salutes the contribution of brands and leaders from many business sectors. White Page follows a rigorous research methodology that evaluates key indicators like growth, reach, infrastructure and innovation.

We are honoured to receive these recognitions which will further strengthen our resolve to fulfil the Carestream brand promise of providing innovative solutions to our customers.

What are the innovations that you wish to bring to India in 2020?

Our R&D teams have developed new offerings that touch every area of our portfolio—with more in our pipeline—to provide customers, dealers and business partners with improved image quality and advanced diagnostic imaging options. Our newest innovations include:

The Carestream Focus 35C Detector with Image Suite Software – an easy way for small facilities and speciality practices to upgrade to DR technology to tap into the power of digital medical imaging. This highly economical system combines advanced image processing with broad operating functionality.

Our enhanced DRX-Revolution Mobile X-ray System offers improved design and workflow, with many new features based on customer input. The tube head and collimator are smaller, lighter and balanced, and display screens are more responsive. Refined brakes and motors are quieter to minimise disturbing patients.

Dual Energy – available on the DRX-Evolution Plus, dual energy

offers excellent image quality for providers and achieves optimal dose efficiency for patients. It captures two images in succession: one at lower-energy X-ray exposure and a second at higher exposure to derive a soft-tissue-only image with the bone structures removed, and another corresponding bone-only image.

Digital Tomosynthesis—available on the DRX-Evolution Plus, digital tomosynthesis acquires a series of individual images from a range of different angles that are analysed to provide depth information regarding patient anatomy. The resulting separation of overlying structures provides enhanced detection of subtle features that can be difficult to visualise in traditional 2D radiographs.

The DRX-Revolution Nano Mobile X-ray System – the first to use carbon nano tube technology to reduce size and weight as compared to other mobile X-ray systems and many more.

What is your message to your customers in India?

Our commitment to be a leader in radiology is as strong as ever. We have the expertise to turn ideas into innovation, and deliver intelligent imaging systems that benefit patients and providers in ways that are critically important to improving the quality of care.

We are bullish about the bright future we have at our company. We have a strong financial foundation, innovative technology and a well-deserved reputation for outstanding customer service and support. Each of us at Carestream will do our very best to exceed the expectations of customers, dealers and partners.

Advancements in computed radiography and digital radiography

Dr Rajeev Mehta - Chairman and Head and **Dr Eshan Thotwe**- MD (Radiology) from Department of Radiology and Imaging Sciences, Saifee Hospital elaborate on how CR/DR these technologies are evolving to provide improved image quality and thereby more accurate diagnosis

Digital images are used throughout radiology. They appear as computed radiography, digital radiography, fluoroscopy, computed tomography, magnetic resonance, ultrasound, mammography, nuclear medicine images. Unlike film images, whose contrast, speed, and latitude are fixed during processing, the appearance of digital images can be altered after they have been recorded and stored. The advantages of digital imaging include the ability to adjust the contrast after the image has been recorded, to process the image to emphasise important features, and to transfer the images to a remote site.

Computed Radiography (CR)

CR is a "cassette-based" system that uses a special solid-state detector plate instead of a film inside a cassette. The exterior dimensions and appearance of the CR cassette are the same as those of a conventional film cassette. The CR cassette is placed in the Bucky tray and exposed in the same manner as a conventional film cassette. The contrast resolution of CR is superior to that of conventional film/screen systems. The CR cassette contains a solid-state plate called a



Dr Rajeev Mehta - Chairman and Head, Department of Imaging Sciences, Saifee Hospital



Dr Eshan Thotwe- MD (Radiology), Department of Radiology and Imaging Sciences, Saifee Hospital

photostimulable storage phosphor imaging plate (PSP) that responds to radiation by trapping energy in the locations where the X-rays strike. CR plates and cassettes can be reused many thousands of times.

Computed radiography (CR) is the most established of the digital

radiography technologies available, having seen more than 30 years of clinical use; yet numerous innovations are currently coming to the market. Some of the drawbacks of CR system namely cassette handling, long read out of plates, low detective quantum efficiency have been addressed by

newer innovations and technological advances.

In automated CR systems with fast readout, there is no cassette handling leading to totally automatic image data acquisition. In these systems the readout time is less than 10 seconds. This can be achieved by newer phosphor for PSP plates. A needle shaped phosphor caesium bromide has been newly introduced and is considered more efficient due to its structured configuration of crystals. It reduces light diffusion because of needle shaped configuration that acts as a light guide. Newer phosphors also have increased detective quantum efficiency.

Newer mobile CR systems are easy to use and offer quick image availability in less than 25 seconds. These mobile units come with integrated CR reader.

Digital Radiography (DR)

DR is used to describe images which are recorded on an electronically readable device that is hard-wired directly to the computer processing system. The detectors and sensors of a DR system are contained inside a rigid protective housing. DR uses an array of small solid state detectors to convert incident X-ray photons to directly form the digital image. The major advantage of the DR system is that no handling of a cassette is required as this is a "cassette-less" system. There are two forms of DR systems: one uses a linear array of detectors, which sweeps across the area to be imaged, the other has an array of detectors formed into a matrix. The linear array records the position of the array and the signal from each detector to form the image.

In the matrix system, each detector provides data for one pixel. The linear array requires fewer detectors but a longer time to form each image. Direct radiography flat panel detectors or imaging plates use a radiation conversion material or scintillator made of amorphous selenium (a-Se) which is a semiconductor with excellent X-ray photon detection

The electrons are transferred and stored in the thin film transistor detectors (TFT). TFT stands for a photosensitive array comprising of small pixels. Each pixel contains a photodiode that absorbs electrons and generates electrical charges. A silicon TFT separates each pixel element and sends the electrical charges to the image processor. The TFTs are positioned in a matrix which allows the charge pattern to be read pixel by pixel. This process takes place very fast where more than 1 million pixels which are capable of being read and converted into a digital image in <1 second. All this information is read with dedicated electronics that facilitate fast image acquisition and processing.

In the last two decades, digital radiography has replaced screen film radiography in many radiology departments. Today manufacturers provide variety of digital imaging solutions based on various detector and readout technologies.

THE DETECTORS AND SENSORS OF A DR SYSTEM ARE CONTAINED INSIDE A RIGID PROTECTIVE HOUSING. DR USES AN ARRAY OF SMALL SOLID STATE DETECTORS TO CONVERT INCIDENT X-RAY PHOTONS TO DIRECTLY FORM THE DIGITAL IMAGE. THE MAJOR ADVANTAGE OF THE DR SYSTEM IS THAT NO HANDLING OF A CASSETTE IS REQUIRED AS THIS IS A "CASSETTE-LESS" SYSTEM

ability and spatial resolution. A high voltage charge is applied to the top surface of the selenium layer immediately prior to the X-ray exposure. The ionisation created by the X-ray photons results in the selenium atoms releasing electrons which are absorbed by the electrodes at the bottom of the selenium layer.

Tomosynthesis

This is one of the important innovations in the field of digital radiography. Multiple low dose exposures are given from various angles while the X-ray tube moves in an arc and the detector remains stationary. Multiple images with different focal zones are possible to be created by addition of these low dose images. It emphasises contrast in particular layer of region of body and is considered useful in intravenous urography studies, mammography and chest radiography.

Dual energy imaging

In this method, by using a high and low

kilo voltage technique, two datasets are created and thus soft tissue and bones can be separately detected. Dual energy techniques are most effective when both images are acquired simultaneously. Similar results are obtained with two exposures within a very short period of time.

This innovation is useful in chest radiography particularly for the evaluation of partially calcified nodules and pleural plaques.

Computer aided diagnosis (CAD) software programmes

These programmes are important in early detection of cancer of the lung and breast. The suspicious areas are marked by the software for review by a radiologist. The efficiency of CAD software programme is related to its sensitivity and specificity profile. The main advantage of CAD is that it permits a radiologist to avoid overlooking diagnostically significant findings.

Automatic image stitching

This recent technique is useful in determining precise measurements in lengthy anatomical regions like spine or lower limbs. It involves multiple sequential exposures at different patient positions which are acquired in a still patient. Later in the process, automatic stitching is performed in order to reconstruct a larger composite image. This special software enables pixel shift and overlap.

Mobile DR

As medical imaging technology continues to advance, the evolution of DR has increasingly moved the modality into the mobile space. With



applications from emergency departments to orthopaedic clinics and more. By putting digital X-ray capability onto a mobile cart-based system, conducting imaging exams anywhere is possible. This allows for quicker exam turnaround times which in turn leads to faster diagnosis. Mobile DR in general is a 17x14 inches flat panel detector connected to mobile X-ray system having a monitor.

The recently introduced LED status light indicator assists the technologist in confirming the status of the system while multitasking at the bedside. This indicator permits greater awareness of when the actual exposure is taking place, as an additional means of warning to the user and other clinicians also working in the same area.

Wireless flat panel detector

This system has no cables and does not interfere with surrounding machines. Typically by this detector a 17x14 inch image is made available within three seconds. This allows

radiography of difficult regions of body like temporomandibular joint, flexed knee and enables radiography in unusual positions.

In future with more data, the capability to learn more and possibility of adoption of new technologies like artificial intelligence, it will change the way mobile DRs get used and more importantly, the role they will play in patient care. Just as the consumer electronics industry is making smaller, lighter, and more durable phones, laptops, and tablets each year, manufacturers of DR technology will definitely try to do the same for detectors and mobile units.

While for the next years, it is likely that DR and CR systems will coexist wherein the long term perspective of CR will be based on further innovations in consideration with the dose efficiency and signal-to-noise characteristics while for DR, economical aspects and broader availability of mobile systems will play a significant role. The future is exciting!

How good quality imaging can perform and how it helps outcomes

Dr Bhawan Paunipagar, CONSULTANT RADIOLOGIST, CO-ORDINATOR OF DEPT OF RADIOLOGY, Wockhardt Hospital Mumbai Central addresses the issue of quality and its importance in correct diagnosis for better treatment outcomes

Quality has become a hot topic in recent years, the entire medical enterprise is being pressured to address quality not only by the public, but also by healthcare services and by regulatory agencies that insist hospitals and physicians measure and improve healthcare quality. Many aspects of healthcare quality have been identified that are lacking and that need regular measurement and improvement.

Radiology is coming under increasing scrutiny by regulators with all parties questioning the value and effectiveness of practitioners. Quality is becoming a critical issue for radiology. Measuring and improving quality is essential not only to ensure optimum effectiveness of care and comply with increasing regulatory requirements, but also to combat current trends leading to commoditisation of radiology services.

A key challenge to implementing quality improvement programmes is to develop methods to collect knowledge related to quality care and to deliver that knowledge to practitioners at the point of care.



There are many dimensions to quality in radiology that need to be measured, monitored, and improved, including examination appropriateness, procedure protocol, accuracy of interpretation, communication of imaging results, and measuring and monitoring performance improvement in quality, safety, and efficiency.

Several important trends are making quality the centre of attention for both radiologists and the parties judging them:

(I) radiology is becoming more visible and central in healthcare delivery,

(ii) there is an exponential growth in medical imaging, and the threat of radiology becoming a commodity in the era of the Internet and international teleradiology,

(iii) imaging is increasingly performed by non-radiologists or by radiologists at remote locations who may not have access to the same information as local practitioners.

Hospitals are responding by looking for ways to track quality indicators and deliver vital knowledge to physicians to prevent errors and improve measurement and monitoring of practice efficiency and patient safety.

NABH (National Accreditation Board for Hospitals) is one such body that plays a vital role in approving and laying down guidelines in the line of the informatics those address quality issues.

Current approaches to quality assessment and improvement are costly, time-consuming, and incomplete. The tasks required are voluminous and data-intensive, challenges for people but not for

BEYOND THE DIRECT PRESSURES ON THE MEDICAL SYSTEM TO IMPROVE HEALTHCARE QUALITY, THERE IS ALSO A BUSINESS CASE FOR QUALITY IN RADIOLOGY

machines. While cost may be a factor hindering adoption of informatics technologies, the lack of education is also important: Few radiologists and administrators are aware of the potential of informatics to provide the functionality they need.

Quality measures are becoming part of the regulatory, compliance, and reimbursement framework. In response to these changes in the healthcare environment, radiologists and hospital administrators are being spurred to plan and implement quality measurement and improvement procedures.

Quality is the extent to which the right procedure is done in the right way at the right time, and the correct interpretation is accurately and quickly communicated to the patient and referring physician.

Beyond the direct pressures on the medical system to improve healthcare quality, there is also a business case for quality in radiology. With the advent of picture archiving and communication systems (PACS), radiology is under threat of becoming a commodity.

Finally, quality is ultimately the core aspect of the professionalism of medicine. Ultimately, radiologists are the best equipped to discover the problems limiting the effectiveness of their practice and to guarantee the

quality of their services. There is a growing perception that all radiologists provide an equivalent service globally and that cost is the only factor that needs to be considered in the marketplace. However, radiologists can differentiate themselves from competitors if they can demonstrate better quality.

Stephen Swensen, Past Chairman of Radiology, Mayo Clinic, makes a compelling argument “Radiology as a commodity will crash and burn in this flat world... For cents on a dollar, you can have images interpreted in other parts of the planet using teleradiology. Unless we can differentiate our product by quality—meaning quality as a combination of outcomes, safety, and service, We have to be able to not just say that we're better; we have to be able to prove it.”

Appropriateness of the examination is represented by the term ‘the right procedure’. There are two aspects: appropriateness of the examination requested by the referring physician and appropriateness of the examination performed (the imaging protocol). Radiologists and referring physicians must be knowledgeable about which imaging procedure is appropriate for each clinical indication. The procedure protocol is represented by

the term the right way. Once the correct procedure is requested, the correct protocol for the procedure must be selected and communicated to the technologist who will perform the study.

Accuracy of interpretation is represented by the term the correct interpretation. Once the imaging procedure has been performed, the images are reviewed by the radiologist. The radiologist's task is to accurately perceive and interpret the imaging observations (radiologic diagnosis). Communication of results is represented by the phrase accurately and quickly communicated. Once the radiologist provides an interpretation and recommendation, those results must be communicated to the referring physician and the patient in a timely manner, depending on the type of result (i.e., critical results vs non-critical results). Radiology interpretation comprises three steps: (a) perception of image findings, (b) interpretation of those findings to render a diagnosis, and (c) decisions and recommendations about case management (next tests or treatments). Each of these steps poses pitfalls to accurate image interpretation. Informatics methods can support radiologists and help them reduce errors during each of these steps.

These methods include just-in-time methods to deliver knowledge at the point of care, computer-aided detection (CAD) to assist with perception, and decision support applications to reduce variation in interpretation. CAD is an informatics method for improving quality by helping radiologists perceive

QUALITY IS NOT JUST OUR GOAL, IT IS OUR RESPONSIBILITY, AND DEPLOYING INFORMATICS METHODS WILL HELP US ACHIEVE OUR OBJECTIVES OF PERFECT DIAGNOSIS

abnormal imaging observations. In CAD systems, a computer programme "reads" the images, detecting particular types of imaging findings that it has been trained to recognise. The central task of these systems is detection of particular imaging findings, such as calcifications, masses, or nodules.

A related task is diagnosis (i.e., interpretation of imaging findings). Because CAD systems seek specific types of image findings, the radiologist should not consider these systems a substitute for evaluating the entire image, as there are many other types of image findings that could be present beyond those the CAD system is trained to detect. Furthermore, CAD systems may not detect lesions that they are built to recognise.

CAD systems generally display regions of suspected abnormality as annotations on the image that the radiologist reviews. The CAD programmes are usually trained to be very sensitive (so as not to miss any true-positive lesions on the images). Consequently, there will often be one or more false-positive findings—CAD annotations on the image that the radiologist believes do not represent abnormalities and can be ignored.

Thus, the CAD reading is often regarded as a second opinion. The diagnosis is ultimately made by the

radiologist, who takes into account the CAD output. Many studies have shown that such second opinions, whether rendered by a radiologist or a computer, increase the overall accuracy of the radiologist.

Finally, measuring and monitoring performance improvement in quality, safety, and efficiency is represented by the phrase patient and referring physician. Ultimately, the effectiveness of radiology is judged by the accuracy of radiologist performance, efficient service, and avoidance of unintended patient complications. Radiologists and institutions must measure and monitor indicators of quality, safety, and efficiency in their services to prove that imaging and their interventions are of high quality.

Responsibility for quality is fundamental to the practice of radiology. Computer applications to measure and improve quality can be successfully deployed. Informatics methods should not be regarded as futuristic developments on the horizon; such applications are already in routine use at many institutions and will likely become more prevalent in the future. Ultimately, as radiologists, quality is not just our goal, it is our responsibility, and deploying informatics methods will help us achieve our objectives of perfect diagnosis for a perfect treatment plan.



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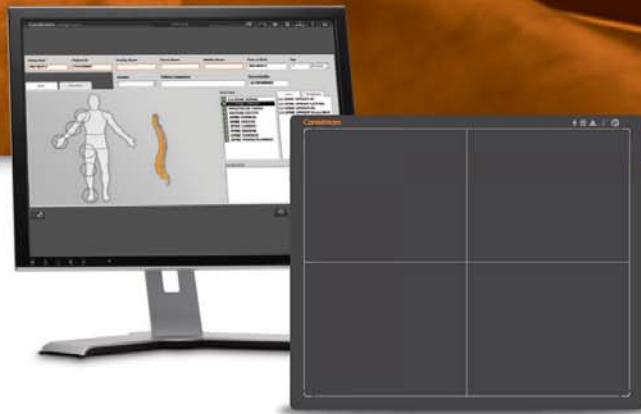
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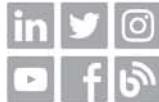
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ESTABLISHING A RESEARCH CULTURE: ARE WE MAKING PROGRESS?

For India to champion research in radiology, very strong organisational structure and clear strategies are essential at the institutional and policy levels

By Raelene Kambli



We all know that research in the field of radiology and imaging sciences has generated several critical technologies. Many spectacular advances in medical sciences and diagnostics that we see today have been centred around radiology. For example, technologies such as magnetic resonance imaging (MRI), computed tomography (CT), ultrasound, mammography and nuclear medicine that are now omnipresent and are a very critical components of the medical decision making process in healthcare have sharpened modern techniques to identify diseases such as cancer.

However, for all the advances and developments so far in imaging technology, radiology research in India has many a times come under criticism in its efforts to assess the effectiveness and appropriate use of advanced technologies. Take for instance, the integration of digital technologies such as artificial intelligence (AI) and machine learning with imaging technology. Worldwide radiologists are indulging in research utilising AI and machine-learning to seek discoveries that can provide novel methodologies for the detection and treatment of complex human diseases. AI in the west has already made a foothold to optimise radiologists' workflow, facilitate quantitative radiology, and assist in discovering genomic markers. But in India very few companies seem to crack the code for such integration and many remain clueless of the positive spin-offs of AI in radiology. So, what keeps radiologists in India away from research? How can we build a research culture in the future?

And how can research really deliver value in India?

Significance and scope

To understand this aspect it is important to know if the true value of research in radiology is well understood. We spoke to some practising radiologists from across the country to understand their point of view and here is what they have to say.

Ascertaining the significance of research, Dr Bhavin Jankharia, Chief Radiologist, Picture This by Jankharia, says, "It is only through research that we can advance the subject. This includes both basic research with animal experiments to study different molecules, contrast media or disease processes as well as human studies, whether they are randomised double blind-controlled trials or whether they are observational studios. The scope in India is huge. We have barely scratched the surface in India. For example, in oncology, apart from diagnosis, radiology helps with biopsies and treatment, as well as developing new molecules that can be used to manage these tumours better, as with the field of theranostics where nuclear medicine substances are used to treat prostate cancer, etc."

As Dr Raju Kalindini, CEO and Medical Director at Apollo Radiology International, Apollo Hospitals puts it, imaging science is a multi-disciplinary field concerning generation, modification, analysis, and interpretation of diagnostic medical images. Therefore, research in radiology is also multi-disciplinary in nature and can occur in the fields of computer science, biomedical,

mathematics and clinical research. But he feels that research has not been the top priority so far. "As we move more and more towards personalised and precision medicine, the role of accurate and early diagnosis becomes even more critical. Hence, advances in many fields of medicine are directly dependant on research in imaging. The highly varied nature of functioning of radiology departments in India that include diagnostic centres, academic institutions, private hospitals, diagnostic and clinics make research quite difficult. For example, in most diagnostic centres which perform a large share of imaging in India, there is a fractured clinical chain with little scope for the clinico-radiological partnerships required for research. However, a lot of high-quality clinical research does happen in the premier academic institutions and Indian authors have been contributing in more noticeable numbers to radiology literature," he informs.

Dr Bhavin Vakil, MD Radiology, Bhatia Hospital Mumbai on Radiology and Imaging Science, begs to differ on this stance. He straight away cites examples of compelling research happening within the sector. "Modern research is seeking discoveries to contribute to advances in the treatment of diseases such as cancer and Alzheimer's disease. In India too, AI has already entered into commercial diagnostics with some organisations deploying Google's Deep Learning application to identify diabetic retinopathy in patients. There are some start-ups that focus on AI-powered diagnostic tools to counter tobacco-related deaths in India. There are initiatives on deep

HERE ARE SOME ADVICES ON WHAT THE INDUSTRY CAN DO TO ENHANCE RESEARCH IN RADIOLOGY



THE INDUSTRY CAN CREATE MORE OPPORTUNITIES FOR RESEARCH IN RADIOLOGY BY PROVIDING FINANCIAL SUPPORT THAT TAKES AWAY THE NEED TO CONTINUE TO SEE PATIENTS TO EARN INCOME FOR THOSE RADIOLOGISTS WHO WANT TO DO RESEARCH

DR BHAVIN JANKHARIA

Chief Radiologist, Picture This by Jankharia



THE FUTURE OF THE DISCIPLINE LARGELY DEPENDS ON THE CRITICAL THINKING SKILLS AND SCIENTIFIC INQUIRY OF TODAY'S RESIDENTS, WHO WILL THEN BECOME TOMORROW'S LEADERS. RESEARCH IS A CRITICAL COMPONENT OF ANY RADIOLOGY RESIDENCY, BUT RESIDENTS ARE STRUGGLING TO FIND ADEQUATE TIME. TO COMBAT THESE OBSTACLES, IT IS INCREASINGLY IMPORTANT TO FOSTER A STRONG RESEARCH ENVIRONMENT AT THE RESIDENT LEVEL WITH EMPHASIS ON INNOVATION, CRITICAL ANALYSIS AND INTERDISCIPLINARY COLLABORATION

DR BHAVIN VAKIL

MD Radiology, Bhatia Hospital Mumbai on Radiology and Imaging Science



THREE SHOULD BE INCREASED AWARENESS ABOUT RESEARCH IN TRAINEE RADIOLOGISTS. TRAINING SHOULD BE FLEXIBLE TO ACCOMMODATE LONGITUDINAL RESEARCH ENDEAVOURS. FOR PRACTISING RADIOLOGISTS WITH AN INTEREST IN RESEARCH BUT DON'T WORK IN ACADEMIC INSTITUTIONS THE INDUSTRY CAN PROVIDE THE REQUIRED SUPPORT. SEVERAL OF THE APPLICATIONS IN THE MODERN IMAGING EQUIPMENT IS NOT BEING USED WIDELY IN INDIA DUE TO LACK OF CONVINCING LOCAL RESEARCH THAT SUPPORT THE BENEFIT OF THESE. IT IS IN THE BEST INTEREST OF THE INDUSTRY TO SUPPORT RESEARCH THAT HELPS RADIOLOGISTS EVALUATE, DOCUMENT AND DEMONSTRATE THE EFFICACY OF THESE TOOLS ON LOCAL POPULATION

DR RAJU KALINDINI

CEO and Medical Director at Apollo Radiology International, Apollo Hospitals



THE ROLE OF INDUSTRY IN COLLABORATION, SPONSORSHIPS AND FUNDING IS VERY CRUCIAL. THIS NEEDS TO BE EXPLORED IN A BIGGER WAY FOR OUR RESEARCH PURPOSES. AND DEFINITELY IT'S BENEFICIAL FOR BOTH THE INDUSTRY AS WELL AS FOR PATIENTS. HOPEFULLY IT WILL HAVE GREATER IMPACT ON RESEARCH IN FUTURE

DR SIKANDAR SHAIKH

Consultant PET-CT and Radiology, Yashoda Hospitals, Adjunct Asst Prof Dept Of Biomedical Engg.
Asst Prof, Dept of Radiology, Shadan Medical College, Hyderabad

learning applications for tumour segmentation as well. Likewise, there is an ample amount of other research too in the field of imaging science in India," he shares.

Adding to this, Dr Vakil points out, "In countries like India where the doctor-patient ratio is reported to be 1:921, deep learning algorithms are being currently used to help radiologists assess cases faster. There are organisations that create algorithms that will make diagnosis for a radiologist quick, easy and accurate. In this, sophisticated AI-enabled decision support tool is used to run standalone or additional information systems. In some places, AI is already being used to detect early stage cancer symptoms, more accurately than conventional methods. Machine-learning models and neural networks can help AI detect such anomalies in a fraction of the time taken by doctors. This is especially crucial in the Indian market, given the size of the population and the lack of intensive diagnostics in many remote areas. Interventional radiology is also seeing continuous advances with aspects like the clinical gene therapy which is rapidly developing and promising."

So what are the areas that show more potential in India?

AI, nano technology sees more traction

According to a paper published during the Radiological Society of North America Congress, imaging research laboratories in the most advanced nations are rapidly creating machine learning systems that achieve expert human performance using open-source methods and tools.

EXPERTS HINT SPECIFIC TO THE SCOPE FOR FURTHER DEVELOPMENTS IN THE FIELD OF RADIOPHENOMICS. AS PER SOME REPORT FROM THE PUBMED, RADIOLOGICAL AND CLINICAL PHENOTYPING HAS FOUND AN ENHANCED ROLE IN GUIDING AND INTERPRETING GENETIC TEST RESULTS

These AI systems are being developed to improve medical image reconstruction, noise reduction, quality assurance, triage, segmentation, computer-aided detection, computer-aided classification and radiogenomics.

India too is following suit and exploring country-specific research, informs Dr Sikandar Shaikh, Consultant PET-CT and Radiology, Yashoda Hospitals, Adjunct Asst Prof, Dept of Biomedical Engg, Asst Prof, Dept of Radiology, Shadan Medical College, Hyderabad, "The biggest research hot cake is AI followed by multi/single randomised trials and efficacy of various modalities going on in various other specialities where

radiology is involved. For example the various cancer drug trials. The other research trials are in the field of imaging efficacy in radiology instruments, comparison in various radiology modalities like MR vs PET in various disease diagnosis, molecular imaging technology for diagnosis of disease and therapeutic aspects of disease. Nano technology is one of the promising area for research. The diagnostic and therapeutic aspects are also involved in nano technology."

Dr Shaikh believes, molecular imaging, nano imaging and robotic imaging have the most potential for research and advancements in coming years. "These are novel modalities to diagnose diseases at the molecular level. The therapeutic option of drug delivery systems by nanotechnology and robotic technology are very promising with very high results in years to come," he feels.

"Today's radiology research is rightly focussed on advances in the diagnosis and treatment of challenging diseases including cancer, tuberculosis and Alzheimer's disease. Radiologists have long struggled with the quantitative and qualitative challenges associated with imaging of these pathologies. The potential of machine learning and AI to radically enhance the scope of imaging in these diseases by its ability to interpret highly complex image patterns at a rapid pace and well beyond the normal human limitations is extremely exciting and can transform the role of imaging in these diseases," adds Dr Kalindini.

Scope for radio genomics

Just as AI and machine learning

applications have seen traction, the other area of interest is genomics and experts hint specific to the scope for further developments in the field of radiogenomics. As per some report from the Pubmed, radiological and clinical phenotyping has found an enhanced role in guiding and interpreting genetic test results. "Genomics and imaging research show great promise for precision medicine to better understand diseases," opines Dr Kalindini.

"The term radio genomics is popularly used to describe the growing field of study at this cross-section of imaging-based molecular phenotyping and genetic assays derived from biopsy. Studying this area has taken researchers into a new frontier of disease diagnosis, risk stratification, therapy assessment and prognostic medicine," expresses Dr Vakil.

Need for fostering clinical research

Well, integration of various digital tools in radiology has seen some success but very little is spoken about radiology and clinical trials. Nevertheless, the need for more clinical research is felt deeply by radiologists across the country. "Clinical trials allow the development, registration and finally access new treatments to patients. Imaging can support the drug development process by providing non-invasive assessment of drug action and disease response for the treatment. Even though size measurement criteria are still the most widely used imaging-based assessment, functional imaging techniques are progressively being used in early phase trials to study the

initial effects of drug action on characteristics of tumour biology," Dr Kalindini further states.

Adding to this, Dr Jankharia speaks of some trials that are already existing. "The imaging aspect has relevance in relation to the new patient benefit. The trials for example already included are the efficacy of anti-cancer drugs after treatment by the new novel drugs. The various trials are also mostly in relation to the diagnosis, treatment response and follow-up of treatment response. Without this, we cannot conclude our efficiency of the drugs and response to treatment where imaging again will be a benchmark for the status of the disease," he asserts.

Dr Vakil expounds further, "Imaging techniques are being rapidly used in oncological clinical trials to provide evidence for decision making. The conventional morphological imaging techniques and standardised response criteria based on tumour size measurements are used increasingly for defining key endpoints. Non-invasive imaging using computed tomography (CT), magnetic resonance imaging (MRI) and fluorodeoxyglucose (FDG) positron emission tomography (PET)/CT plays a seminal role in generating primary, secondary and exploratory study endpoints. In later stages of oncological drug development, imaging forms the basis of robust response and progression criteria to interrogate the drug in a large number of clinical trial subjects."

While there is some good work happening in silos, experts feel that there is not much backing from the institutions, govt, etc. Dr Jankharia is quiet abrasive while he speaks of

Indians and their sense of attitude towards research. He says, "We just don't have it in us to do good research." But the others, dissent this accusation. Most experts believe that the challenge at hand is multi-faceted.

"The challenges that modern radiology research face is several including increasing workload and the shortage of qualified labour. There is also a growing demand to keep up with quality standards and to document proper performance. Digitisation is another challenge for radiology. Although experts agree that AI and big data analytics will not replace radiologists any time soon, there is still some concern," shares Dr Vakil.

Similarly, Dr Kalindini points out that the pursuit of conducting research as a radiologist is challenging especially in India because most of the radiologists have limited time built-in for research due to increasing clinical demands. "The varying ecosystems of radiological practice, as discussed earlier, is also a major barrier. Successful research in radiology requires an integrated multi-disciplinary team approach which is not possible in set ups like diagnostic centres," he adds.

As rightly indicated by Dr Kalindini, undertaking research of the highest quality involves multitude of factors which can create a far reaching impact. Ensuring access to funding, career progression for researchers, increasing clinical engagement and improving the research infrastructure can really help boost research activities in future.

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Pelvic floor ultrasound : An underutilised but useful diagnostic tool

Dr Sameerkumar Shah, Consultant Radiologist, Founder, Canpic Medical and Education Foundation, Pune, India, explains the usefulness in diagnosis, quantification, classification and follow up of pelvic floor disorders

Pelvic floor disorder affects about 50 per cent of women worldwide in different conditions like physical, psychological, sexual, social, domestic relationships, financial, etc. There is limited knowledge amongst doctors as well, apart from little awareness of pelvic floor health amongst general people. This results in lesser efforts to prevent or treat these disorders. These disorders remain asymptomatic in about 10 – 20 per cent cases.

Why pelvic floor ultrasound?

In the next 30 years, 45 per cent increase in diagnosis and management of pelvic floor disorders is expected and imaging (especially sonography) will play a major role in this. Ultrasound can be helpful in evaluating both men and women with a variety of pelvic floor disorders. Including undiagnosed disorders like e.g. pudendal canal syndrome. Transvaginal and trans-abdominal ultrasound has been used for a long time to visualise the uterus and adnexa for various pathologies like fibroid, ovarian cyst, and endometrioma. Pelvic floor



ultrasound helps in visualisation of pelvic floor organs, muscles and other related structures. It is a useful tool for diagnosis, quantification, classification and follow up of pelvic floor disorders. Dynamic and multi-compartmental anatomical and functional assessment is possible with ultrasound.

E.g. assessment of pelvic floor muscle activity plays a major role in urogynaecology. Presence of levator avulsion/injury is a major risk factor for female pelvic organ prolapse and recurrence after surgical correction.

This can be diagnosed clinically using vaginal palpation which is subjective, less reproducible, and difficult to teach than imaging methods. Ultrasound plays an important role here.

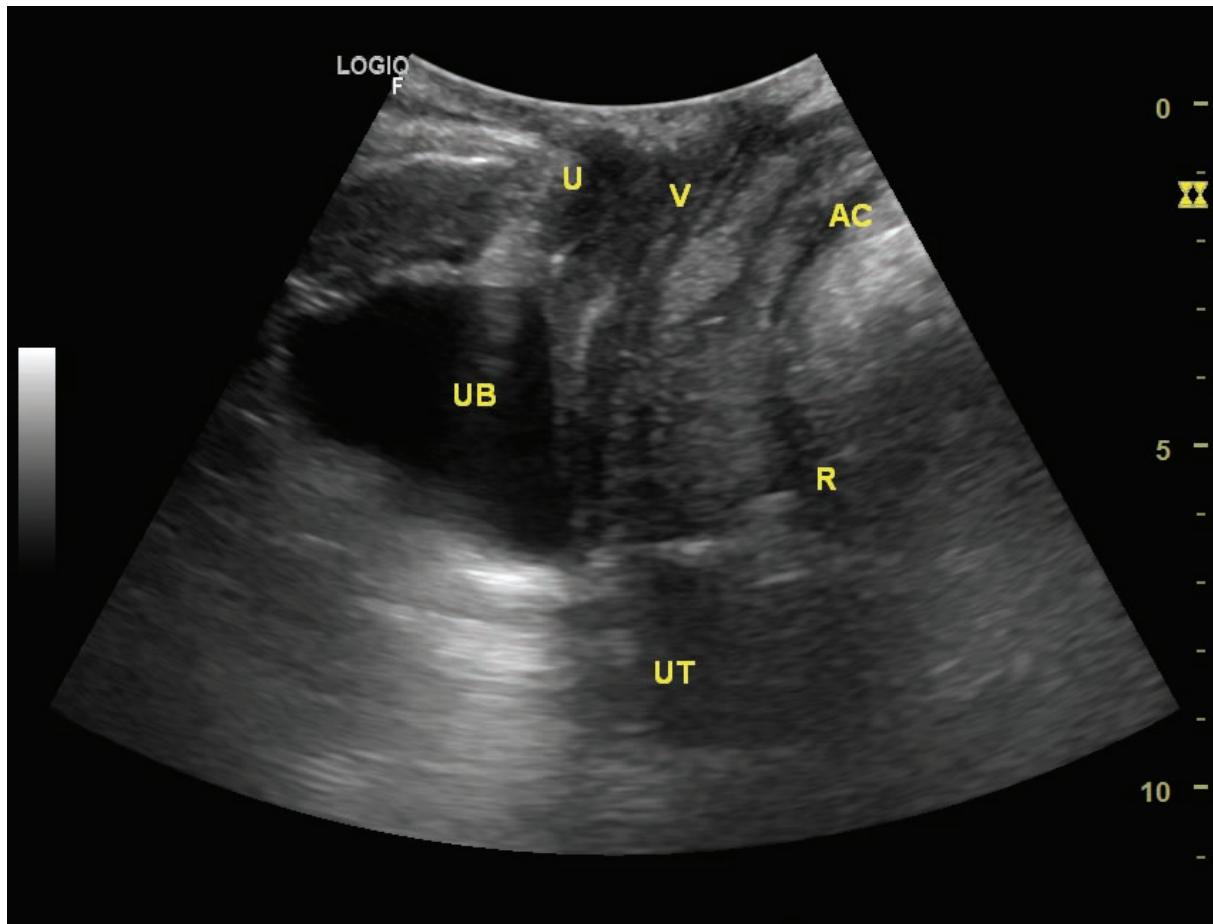
Ultrasound has many advantages over other imaging modalities like defaecation proctography and defaecation MRI. These include wide availability, intra-operative usage, no radiation, less time consuming, low cost, portability, better evaluation with dynamic studies, easy reproducibility, safety, better visualisation of mesh and implants. Disadvantages of sonography are few and include smaller field of view and operator dependency.

Technique of pelvic floor ultrasound

Study is done after emptying the urinary bladder. Positions used are modified lithotomy, standing or lateral decubitus position. Pelvic floor structures are evaluated at rest and during Valsalva exercise. Precautions are taken to avoid simultaneous levator ani muscle contraction during Valsalva and avoid probe pressure on the introitus allowing the organs free mobility. All

MRI/ULTRASOUND

Pelvic floor ultrasound anatomy



U = urethra, UB = urinary bladder, V = vaginal canal, UT = uterus, AC = anal canal, R = rectum

types of probes are useful including 2D linear, convex and trans-vaginal probe, 3D convex and trans-vaginal probe. Transperineal, translabial, introital scanning with convex probe is usually done. A radial endocavitory probe with 360° cross-sectional image- for endoanal and endovaginal studies- allows in detail anatomical visualisation of the pelvic floor and provides minute details of levator plate integrity and pelvic organ alignment. All scan planes

sagittal, axial and coronal provide excellent images of various pelvic floor structures like urinary bladder, urethra, vagina, uterus, rectum, anal canal and levator ani muscles.

Indications and clinical impact of pelvic floor ultrasound

Ultrasound allows evaluation of the anterior, middle and posterior pelvic floor compartments. Multi-compartmental assessment is

essential for planning the treatment as multiple pathologies often co-exist. Treatment must address all components, failing which results in suboptimal outcomes.

All types of pelvic organ prolapse are diagnosed and quantified using ultrasound. Green classification of cystocele is useful and depends upon the degree of retrovesical angle on Valsalva exercise. Surgical management is different for Green type II and type III cystoceles. This

MRI/ULTRASOUND

explains high recurrence rate in cases which are managed without considering this important aspect.

Stress urinary incontinence can be easily diagnosed clinically. Urinary bladder neck mobility is well visualised in sonography. It is useful in diagnosing it in situations where it is clinically masked (potential incontinence) with its cause like a pelvic organ prolapse. It's useful in selecting appropriate site for a sling (TOT or TVT sling) placement and detecting various complications of a sling like abnormal position, migration, outlet obstruction, urethral erosion and transaction. Under or over correction is possible to assess by studying the shape of the sling. Urinary incontinence after radical prostatectomy in males is studied in a similar way quantifying the bladder neck descent.

Three dimensional ultrasound can diagnose Fowler Syndrome by measuring the volume of the urethral rhabdosphincter in females. Skene's gland cyst and abscess is visualised excellently.

Various lesions affecting central compartment, apart from organ prolapse are diagnosed, which include Bartholin's gland cyst and abscess, vaginal inclusion cyst, sebaceous cyst, epidermoid cyst, edema, varicose veins, and tumours like lipoma, fibroma. Lesions like haematocolpos and haematometrocolpos are better evaluated through transperineal approach. Diagnosis of vulval, cervical and lower uterine segment varices during pregnancy is essential and life saving. A caesarean section is planned in advance to avoid post partum haemorrhage

which could be torrential and fatal. Pneumovagina(excessive air in vaginal canal) and its etiology like pelvic floor laxity, infectious vaginitis and ano or recto-vaginal fistula are also diagnosed.

Patients who have chronic constipation may have anterior or posterior rectocele, enterocele, recto-enterocele, sigmoidocele, rectal intussusception or anorectal dyssynergia. All are diagnosed, graded and the response to treatment is studied using dynamic sonography.

Cause of faecal incontinence is easily diagnosed and accurate measurements of anal sphincters is possible especially with 360 degree radial endoanal ultrasound probe. The same probe is of immense help to classify and study various types of anal fistula and anorectal abscess. Special anatomical types of fistula like anovaginal and anovulvar fistula are excellently evaluated.

Anal sphincter injuries due to obstetric trauma or any other cause are seen best on 360 degree radial endocavitory probe. Intra-operative study measures the reconstructed sphincter accurately in all three dimensions and is useful to close the surgery after endorsing successful reconstruction. Both endovaginal and endoanal approach provides better results. This prevents re-exploration.

Chronic perineal pain is common and it is difficult to find out the etiology. Sonographic evaluation of muscles here diagnoses the trigger points in myo-fascial pain syndrome. Trigger points are better evaluated using ultrasound elastography with pre and post treatment assessment

of the stiffness and size. Pudendal canal syndrome is diagnosed on Colour Doppler evaluation of internal pudendal artery and venous channels. It is quite rewarding to do justice with these patients as this disease is under-diagnosed.

Male and female sexual dysfunction is an area for which ultrasound is underused. Atrophy of superficial perineal muscles — which are best assessed using sonography — could be the etiology of erectile dysfunction in males. An interesting phenomenon known as persistent sexual arousal disorder (PSAD) is seen in females and one of the cause is clitoral and vulval varices — seen on ultrasound — most likely secondary to pelvic congestion syndrome .

Various guided procedures are made easy with ultrasound e.g. pudendal nerve block in pudendal neuralgia, dry needling for trigger points in myo-fascial pain syndrome, etc.

Pelvic floor ultrasound is a simple, inexpensive, useful yet under-utilised tool for diagnosis, quantification, classification and follow up of pelvic floor disorders. Dynamic and multi-compartmental anatomical and functional assessment is possible which avoids exclusion of co-existing disorders. It is justified to suggest pelvic floor sonography in a patient with suspected pelvic floor disorder, considering the several indications and high prevalence. This article is an attempt to create awareness amongst general people as well as medical fraternity, to do justice with patients with pelvic floor disorders.

Current scenario and future prospects of MRgFUS in radiology

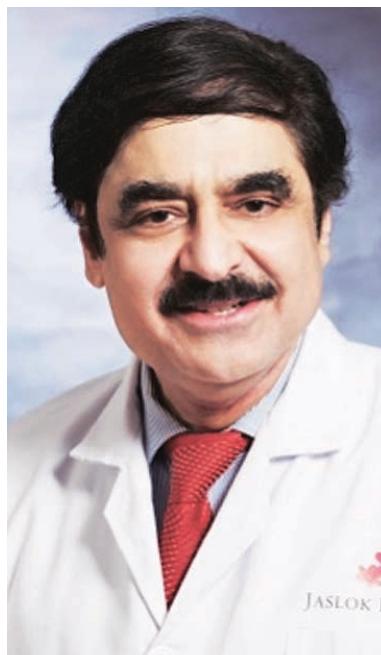
Dr SB Desai Director, Department of Imaging and Interventional Radiology, Jaslok Hospital and Research Centre and

Dr Ritu Kashikar, Consultant, Department of Radiology, Jaslok Hospital and Research Centre, explain how MrgFUS technology can be used for the treatment of various cancers

MRgFUS is one of the most highly innovative technologies introduced to the medical sector in recent years. It is a cutting-edge technology making incision-less surgery a standard of care for patients. Focussed ultrasound technology uses sound waves that pass safely through skin, muscle, bone, etc. The specific area where the sound waves converge is heated to temperatures that cause thermal ablation. With the help of MR imaging, a complete anatomical survey of the treatment area allows for patient-specific planning and real-time monitoring.

This path-breaking technology can be used for the treatment of various conditions like uterine fibroids, adenomyosis, backache due to facet arthropathy, bone metastasis, bone tumours like osteoid osteoma and prostate cancer.

Uterine fibroids also referred to as leiomyomas or myomas, are benign muscle tumours in various locations in the uterus. Many women who have uterine fibroids suffer from a range of symptoms, including pain and heavy menstrual bleeding. The technology



Dr SB Desai Director



Dr Ritu Kashikar

provides a non-invasive option for treating symptomatic uterine fibroids with the help of MR-guided Focussed Ultrasound (MRgFUS).

During treatment, the ultrasound beams are focussed to a focal point and thereby they heat and ablate targeted

tissue. MRI guide the treatment which provides high-resolution images of the target and adjacent structures, it also helps continuous temperature monitoring. The cumulative thermal impact on the tissue can be analysed by temperature data. If necessary,

parameters can be adjusted to ensure an optimal response.

MR-guided-focussed ultrasound can also provide a non-invasive and non-radiation treatment option for the pain palliation of metastatic bone cancer. This treatment has been shown to provide significant pain relief, an improvement in the quality of life and a reduction in the need for pain medication in certain patients who have failed, who are not eligible for or who refuse radiation therapy. This treatment can also be used to treat painful benign lesions like osteoid osteoma.

Facet arthropathy is a common cause of low backache and stiffness. With MRgFUS we can ablate painful nerve endings around inflamed facets thereby alleviating pain caused by the disease.

Out of nine men, one will be diagnosed with prostate cancer during their lifetime. With PSA screening, many men are diagnosed with the locally-confined disease with low or intermediate risk for progression. The Exablate Prostate treatment is a minimally invasive (involves very less incisions in the body), focal treatment for locally-confined prostate cancer.

In the course of the treatment, the aim of ultrasound waves is focussed to heat and ablate the identified cancerous tissue. Real-time imaging for precise targeting and to avoid adjacent organs such as the neurovascular bundle (NVB), the urethra and the rectal wall is provided by MRI.

The benefits over other treatments include, incision-less treatment which has little risk of infection and no scarring from incisions, organ-preserving, minimal hospitalisation, a quick return to activities, low risk of

MR-GUIDED-FOCUSSED ULTRASOUND CAN ALSO PROVIDE A NON-INVASIVE AND NON-RADIATION TREATMENT OPTION FOR THE PAIN PALLIATION OF METASTATIC BONE CANCER

complications and hence significant improvement in the quality of life. Women undergoing this procedure can have normal reproductive lives without adverse effect on fertility. Unlike standard surgeries for prostate cancer which involve a significant risk of impotence and incontinence, this procedure protects vital structures and hence completely negates chances of these complications. Treatment such as facet arthropathy can be treated on daycare basis without the need for hospitalisation.

With over 2000 patients treated, we at Jaslok Hospital are proud to announce that we have performed the third-highest number of MRgFUS procedures in the world. This consists of over 1600 fibroids, 200 adenomyosis, 125 facet joints, 25 bone metastasis, 10 cases of prostate cancer.

Another exciting application of MRgFUS is in the treatment of essential tremors. With MRgFUS, we can do sub-thalamic nucleosone without burr hole or craniotomy. The results are immediate and unbelievable. There will be extended applications in neurological disorders like treatment of epileptogenic focus, psychogenic disorders and debulking of inoperable tumours.

However, in a country with a population of over 1.3 billion, of which 0.6 billion are women, of which 0.2

billion suffer from fibroids, our numbers seem minuscule. India also has a high number of patients with prostatic cancer and bone metastasis and bearing these figures in mind one would ponder as to why the numbers of MRgFUS patients are nothing but a fraction.

Our vision is to make MRgFUS a standard of care for patients, to increase awareness both amongst patients and physicians.

However, the success of our vision remains obstructed by various obstacles. Poor awareness, poor acceptability and apathy for embracing a new technology amongst referrals is our foremost hindrance.

The future of medicine lies with minimally invasive procedures such as asMRgFUS. We at Jaslok hospital aim to increase awareness, availability, the cost-effectiveness of this avant-garde technology in our country. With the active support of social media, NGOs, different medical forums, and hospitals, we aim to create more knowledge about this procedure amongst the larger populations.

As research continues and more patients seek non-surgical, non-radiation alternatives to their medical conditions, practitioners of MRgFUS see hope for more widespread adoption for this breathtaking and path-breaking treatment modality.

Expanding frontiers of MRI

Dr Sona Pungavkar, Senior Consultant Radiologist, Global Hospital, Mumbai, gives an overview on the major advancements in MRIs and explains how they provide great anatomic and physiological information

"The capacity to diagnose is the most important part of the medical art — Hippocrates

Thus, Imaging and Radiodiagnosis are an integral part of modern management of patients and also form the base for the clinicians to mount the treatment plan.

With the discovery of X-rays by Roentgen in the year 1895, a way to get insight into various body parts was provided. However, this technique was fraught with the dangers caused by radiation.

Ultrasound uses sound waves and is a safe technique to assess the body parts, including the foetus, though it is not useful for bones, brain, spine with limited use for joints. Doppler ultrasound, with the additional use of colour, assesses the interference caused by tissues and flowing blood to long frequency sound waves and produces information in terms of images as well as velocity measurements.

Evolution in the field of X-rays and computer science led to the discovery of Computed Tomography (CT) which formed images in three dimensions, unlike the two dimensional pictures of the X-rays. It gave access to the inside of the calvarium and allowed imaging of bones. However, because of the use of electrons, the capacity to differentiate



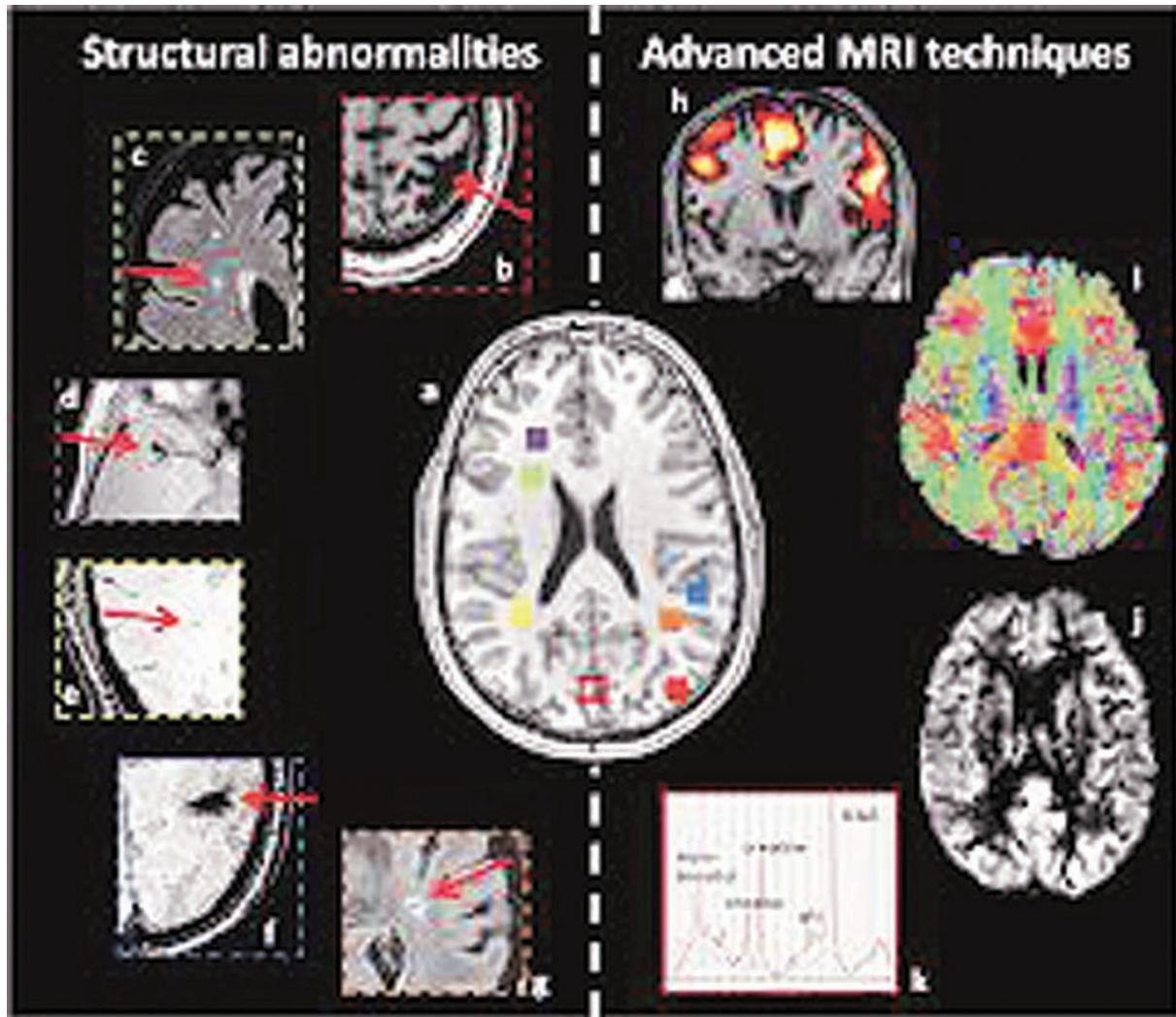
between different tissues is limited and the side effects of radiation still limit the use.

The discovery of magnetic resonance imaging (MRI) revolutionised imaging in an unimaginable way. It is a very safe technique, which does not use radiation, but allows magnetisation of the tissues in a target area, imparting electromagnetic energy to the protons (H^+) in the area. Good pictures can be obtained because the water or proton content between the tissues varies, and hence the ability to discriminate between these increases. Thus, finally unparalleled views were possible inside the brain, spine, soft tissue as well as the foetus using fast scanning techniques, which allows sub-second scanning.

Ultrafast MRI has been a major advancement in newer MR techniques. Administration of safe gadolinium-based contrast can add information regarding the diagnosis. MR angiography can map the flow in the arteries and veins in the body without the use of contrast.

Not only the anatomic information is great, but further progress in MRI allowed availability of physiological information regarding the tissues including the brain, liver and muscle. This has been a huge step forward and led to the development of MR Spectroscopy, MR Perfusion, Diffusion weighted imaging (DWI) and Diffusion Tensor Imaging (DTI) and Functional MRI (fMRI). However, these techniques required developments in the magnet and coil designs as well as in the software, which fortunately happened paralelly.

MR Spectroscopy provides information about chemical milieu of certain organs, the data of which is received in the form of a frequency plotted on a spectrum. Brain was the organ most explored and pre-intervention histopathological diagnosis and grading of tumours became a possibility to guide management. Differentiation between a pyogenic abscess and a necrotic neoplasm can be done. A neoplasm is



expected to have an increase in choline and reduction in N-acetyl aspartate acid (NAA), whereas a spectrum from a pyogenic abscess displays multiple amino acids. Low grade tumours contains lower amount of choline with preserved NAA peak, whereas a higher grade would have higher choline and negligible NAA, thus providing a clue to grading pre-operatively and avoiding sampling errors.

Even without any focal abnormality

as in hepatic encephalopathy or hypoxia, the spectral pattern can indicate presence of ammonia or lipid lactate in the brain, respectively. In conditions such as Alzheimer's or Pick's disease, decrease in the number of neurons by serial comparison or comparison with an age-matched adult is possible, as NAA serves as a neuronal marker. MRS studies of newborns and infants can detect presence of lipid lactate which may be due to hypoxia or

other metabolic diseases. Also, it can help to detect diseases such as leukodystrophy with early characterisation. For instance, NAA peak is elevated in children with Canavan's disease, when there is white matter abnormality on conventional MRI, thus obviating the need for brain biopsy.

DWI and DTI uses the principle of Brownian motion. In normal state, water in the tissues is in random

MRI/ULTRASOUND

motion, whereas in the disease state there is restriction of the motion. DWI has a huge role in early assessment of infarcts in the brain as well as indicate cellularity in malignant lesions.

Epidermoids and abscesses in the brain show restriction of diffusion, whereas, an arachnoid cyst does not. DTI uses information of motion in several directions, enabling visualisation of fibre tracts in the brain and also delineating the direction. These can be colour-coded and have a huge impact in neuronavigation or guided neurosurgery.

MR Perfusion is a technique which assesses the passage of contrast into an area of interest during the first passage. Low grade lesions take up contrast slowly and persist to enhance, whereas malignant lesions take up contrast earlier and allow it to escape early. In imaging of stroke, the amount of viable tissue is indicated by diffusion-perfusion mismatch, which is also called as the penumbra. It is the guide for intervention in the patients who arrive to the emergency in good time.

MR Perfusion can also be performed without the use of an exogenous contrast with a technique called as three dimensional Arterial Spin labelling (3D-ASL). In ASL, the flowing blood is tagged with an electromagnetic wave and then the brain is imaged after a lag time. This information subtracted from baseline data provides a map of the cerebral blood flow in the brain. This technique does not depend on the size of the vein cannulated, speed of injection or post-processing as needed in contrast perfusion. Also, it can be easily repeated, as it does not require the use of contrast. Hence, it is useful in paediatric patients and patients on surveillance for brain tumours, as well

as in imaging of stroke, where serial follow up is necessary. Velocity selective ASL (vASL) allows tagging of flowing blood in a particular vessel providing different colour code for the same. Thus, the vascular territory of the targeted vessel is colour coded and collateral flow can be determined in a particular area.

Neuronavigation is used in mapping the brain tissues prior to surgery or intraoperatively as in an intraoperative MR system, where the information can be obtained in real-time. This is used in neurosurgery with open or closed magnets, the latter providing higher quality of MR images. Thin MR sections are also integrated in the treatment planning systems to provide high precision in mapping of the target area and protecting the sensitive structures in the vicinity, mainly in brain tumours and less frequently in neck and pelvis.

fMRI is the mapping of the active areas of the brain involved in performance of tasks such as motion, speech, thinking, hearing, seeing etc. This technique relies on the speed of acquiring the data and is being refined as progress keeps happening.

High field MRI, which include 7T magnets have become available in a few research institutes in the world. These provide increased signal to noise ratio, which translates into higher resolution. The use has potential to predict early biomarkers for cerebrovascular and neurodegenerative diseases.

Clinical hybrid positron emission tomography (PET)-MRI is now available. MRI provides detailed soft tissue intrinsic, diffusion weighted imaging, dynamic contrast imaging, fMRI and other specialised sequences as well as MR Spectroscopy. PET provides physiologic information. PET-

MRI avoids the harmful effects of radiation that the patient is subjected to during PET-CT, where both the imaging modalities cause side effects, especially in paediatric patients. The two types of information provided are combined by fusing PET-images on anatomic MR images and also utilising functional data available by fMRI and MRS. The data is obtained simultaneously, so co-registration of the data is accurate. PET-MRI has several potential applications, an important one being providing greater accuracy to detect metabolically active disease during surveillance of brain tumours, localising seizure activity, mapping brain activity in diseases such as dementia, in better delineation of neck and pelvic cancers.

Low and high intensity guided ultrasound (LIFU and HIFU, respectively) are new techniques to treat focal lesions in the brain. LIFU can open the blood brain barrier to allow targeted treatment to penetrate the diseased tissues and increase efficacy, while reducing the dosage of the drug. It also has the potential to allow new treatment options for diseases like Alzheimer's. HIFU can actually cause cell death and necrosis and can be used in treatment of focal brain lesions such as tumours.

A major role of MRI includes providing diagnostic and therapeutic endpoints in clinical trials, as its ability to penetrate the body at microscopic levels increases.

The newer magnets scan more, scan faster and scan more efficiently. As the use of MR magnets increases, awareness regarding MR-related safety needs to be included in the basic curriculum in medicine and nursing to avoid associated complications.

Advances in the Teleradiology Sector

Dr Arjun Kalyanpur, MD, Chief Radiologist and CEO, Teleradiology Solutions, Bengaluru, India speaks about the trends and prospects that teleradiology brings to healthcare

The last decade has been a truly exciting one for the teleradiology sector, which in its currently established form is about two decades old, i.e. as old as the current millennium. The first decade of this millennium had teleradiology proving its credibility as a potentially transformational technology innovation that could provide much needed support to radiologist-starved hospitals and diagnostic centres, emergency departments and perhaps most importantly, to other overworked radiologists. Over the second decade 2010-2019, however, teleradiology has seen exponential scale and has evolved into an industry unto itself. The main advances and trends facilitating this growth of teleradiology, which we have witnessed through the perspective of our own global clinical teleradiology practice have been:

1. Increase in utilisation of teleradiology – Once the initial concerns and doubts about its efficacy and safety were addressed, the sheer need for teleradiology based on critical radiologist shortages and dramatic increases in utilisation of imaging have driven its explosive growth. In our practise we have seen that the growth has spanned all geographies from the most technologically advanced



metropolitan cities of the United States to remote and backward parts of Africa and Asia where healthcare delivery is still primitive. Similarly, all modalities have been impacted by teleradiology from plain X-rays to PET-CTs. And market surveys which a decade ago tentatively hinted at teleradiology growing into a 1-billion-dollar industry today seem to confidently proclaim that it will soon cross 10 times that number.

2. Clinical applications driving the need for teleradiology – Driving the demand for teleradiology has been a profusion of clinical applications in

which teleradiology makes significant impact.

a) A classic example is acute stroke. In our US clinical teleradiology practice we have seen a significant increase in both the number of centres accredited as stroke treatment centres and the corresponding number of stroke imaging scans being performed (now including CT angiography and perfusion imaging). This means that thousands of images per patient need to be interpreted in an ultrashort time frame, typically within 10 minutes. Further, trauma and emergency imaging in general are increasingly utilised. In the US it is estimated that CT imaging of the spine for trauma increased by 400 per cent from 2006-2016 and Vascular CT angiography by 300 per cent over the same time period. As after-hours radiologists are hard to find in the current environment, teleradiology steps in as the provider of choice.

b) At the opposite end of the urgency spectrum even screening examinations such as chest X-ray for TB, low dose screening CT for lung cancer detection and mammography are able to realise greater adoption when combined with teleradiology interpretation. In parallel, the radiologist shortages have become even more acute, despite efforts to

train more personnel, which are thwarted by the challenge that today radiologists in many instances are too busy with clinical work to be able to dedicate sufficient time to train the next generation. Hence, more teleradiology utilisation (and online education to train radiologists, but that's another story...).

3) Cloud technology promotes the growth of teleradiology - From a technology standpoint one of the transformational trends in teleradiology over the past decade has been the spread of cloud based technologies which allows doctors and medical centres to set up and use teleradiology without investing in expensive hardware. Thus, there is a cost reduction by reducing the need for high-end onsite servers. It has also led to greater saleability of teleradiology as the ability to add on server space incrementally, rather than in quantum mode, is facilitated by cloud technologies. Also as server and internet bandwidth costs have dropped, the ability to reliably archive data offsite has become a reality. Rapid/immediate deployment of teleradiology services - as in the pay-as-you-grow model, such as the one afforded by our technology workflow Radspa, wherein any radiologist wishing to practice teleradiology can sign up for and switch on instantly, has accelerated adoption.

4) Teleradiology increases radiologist efficiency with workflow tools, viewer embellishments - Over the past decade the focus of teleradiology has been on further improving the reporting efficiency of radiologists by using an amalgamation of efficient viewer

THE FIRST DECADE OF THIS MILLENNIUM HAD TELERADIOLOGY PROVING ITS CREDIBILITY AS A POTENTIALLY TRANSFORMATIONAL TECHNOLOGY INNOVATION THAT COULD PROVIDE MUCH NEEDED SUPPORT TO RADIOLOGIST-STARVED HOSPITALS AND DIAGNOSTIC CENTRES, EMERGENCY DEPARTMENTS AND PERHAPS MOST IMPORTANTLY, TO OTHER OVERWORKED RADIOLOGISTS

design, structured reporting, voice recognition and radiology lexicons all of which are driven by the increased workloads and radiologist shortages, a challenging scenario in which teleradiology provides its greatest value. Teleradiology workflows focus on ensuring that every second of radiologist time is optimally utilised.

5) Teleradiology enables working from home, part time: New service and business models have emerged in the past decade due to the proliferation of teleradiology

services. The number of radiologists working part-time from home offices has increased in geometric progression which allows for better utilisation of that exceptionally valuable resource, that is radiologist time. This has also allowed for segments of the workforce who were previously unproductive such as young mothers and those dealing with elder care issues to remain productive in the workforce and equally importantly to retain their radiology skills. Teleradiology also facilitates a per-read reimbursement model that translates into more efficiency and greater productivity in reporting than the traditional salaried reimbursement model.

6) Recent governmental adoption and tendering process for teleradiology - A significant advance in teleradiology over the past decade has been a consequence of the realisation on the part of the government that it is unable to effectively address on its own the radiology needs of the community and its embracing public private partnership models which use teleradiology workflows to deliver valuable access to remote areas in a public health environment. Our work with the government of Tripura has illustrated the power of collaboration between the private sector and government using teleradiology as a bridge to provide radiologist access to district hospitals and community health centres to rural populations in remote parts of India.

7) 3D Teleradiology Lab - the use of outsourced 3D post-processing services for generation of high quality volume data that facilitates

TELERADIOLOGY

surgical planning is an important offshoot of teleradiology that has been firmly established over the past decade. Our work with the Harvard MGH 3D Lab providing after hours post-processing services to a luminary tertiary care metropolitan hospital site is an illustration of the value of this service. From the technology standpoint, the convergence of 3D workstations with teleradiology workflow is a new advance that increases and enhances the reach and value of both.

8) Teleradiology core lab facilitates drug discovery and clinical research – In the last decade, there has been a resurgence in drug discovery related research in the pharma and biotech sector in the country while the industry has only continued to grow at a global level. The use of teleradiology-driven Core Labs, such as our own Image Core Lab, by the pharma/biotech sector has significantly increased, as has the creation/adoption of teleradiology workflow such as Clinspa which are focussed on the unique requirements of clinical research-related radiology reporting such as dual read with adjudication, quantitative imaging and the use of objective reporting standards such as RECIST. Teleradiology has proven itself to be a major value addition in drug discovery and clinical research.

9) Teleradiology-driven education and second opinion sites- The increasing use of teleradiology for second opinions and subspecialty consultations especially through web-based services to which anyone can upload their imaging data marks another success story for

teleradiology in recent times. And the growth in popularity of teleradiology-driven online education websites portals for radiology education parallels that of the Internet as the foremost source of information and learning today. We currently have users from all across the world logging on to our live e-lectures by luminary international guest speakers.

10) Teleradiology and AI, the next big thing – Of all these, by far the most exciting development in the teleradiology space has been the emergence and realisation of growing synergies between it and the new and precocious kid on the block, namely artificial intelligence and its conjoined twin, deep learning. Both teleradiology and AI thrive in the environment of clinical complexity, computational and networking technology and big data and both seek to solve the same fundamental challenge of too many images and not enough radiologists. Teleradiology provides an exceptional environment for the development, validation, testing and finally the deployment of deep learning algorithms. The integration of AI algorithms with teleradiology workflows can help make the radiologist more efficient and more accurate. For instance, we have deployed an AI tool that can auto detect a brain bleed into our ER teleradiology practice which enables stroke cases to be triaged immediately as positive or negative. This represents a pivotal moment in the evolution of the new age technology enhanced super-radiologist. AI is the catapult that will propel teleradiology into the new

decade and beyond.

To summarise, from a teleradiology perspective, very exciting times lie ahead... and to paraphrase the old time jazz singer Al Jolson.... we ain't seen nothing yet!

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Sanrad Medical Systems

ScintCare CT16



ScintCare CT16 was developed by FMI, the subsidiary of MinFound after five years of R&D, the ScintCare CT16 has become a high-end 16-slice CT with optimal resolution. ScintCare CT16 is able to meet the high throughout scanning demands of the AAA hospitals, moreover, it also can meet the needs of the various clinical examinations in the county level clinical centres.

The FMI operations in the US has focussed on research and development and designing high-end medical imaging equipment in collaboration with the research and development team at MinFound. The team has successfully developed CT and PET/CT systems and has successfully obtained the CFDA clearance to market and sell the CT and PET/CT systems.

Global procurement ensures high reliability

- Scintistar detector
- DUNLEE large heat storage tube for multi-slice CT
- Spellman HV Generator
- MOOG military-grade slip ring
- Franke aerospace quality precision heavy-duty bearing

The integrated casting of stator and rotor

The rotor and stator of the gantry are both made by a precise casting process to ensure their mechanical stability and rigidity during high speed rotation. There is virtually no deformation to the source and detector alignment during rotation, ensuring artifact-free image quality.

High performance imaging system

- Retina Solid State Detector

technology to ensure high image quality.

- Ultrafast Scintillator Technology and application Optimised algorithm to enhance image details.
- Intergrated AntiScatter Grid (ASG) and A/D technology (ASIC) to maximise SNR.

Better and pleasant user experience

- Long-term image quality achieved by innovative calibration algorithms.
- Efficient design of the gantry to achieve structural stability under high G-Load.
- Optimised air flow to guarantee long thermal stability for wide range of ambient temperature

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ScintCare PET/CT



ScintCare PET/CT, is the first SiPM-based digital PET/CT is an affordable high performance nuclear medical imaging system that MinFound has developed

ScintCare PET/CT, is the first SiPM-based digital PET/CT is an affordable high performance nuclear medical imaging system that MinFound has developed in only four years. ScintCare PET/CT is a unique molecular imaging system that won both the special approval of Chinese innovative medical equipment, and the innovation product certificate issued by the National Health Planning Commission, Chinese Hospital Association and China Association of Medical Equipment.

The first SiPM-based digital PET/CT

- Free breathing scan
- 20.2 cm long axial coverage
- 0.97 per cent system sensitivity
- 3.5 mm PET spatial resolution

The integration of the SiPM digital PET detector and scintillation crys-

tal

- Higher photon detection efficiency and light output uniformity
- Better time resolution, spatial resolution and image uniformity
- Patented fast-correction technology based on SiPM 1:1 readout method

Systems is equipped with ScintLaSante software which can reveal subtle changes

- iRecon, an intelligent reconstruction technology, reveals the subtle lesions
- IPSF, a resolution recovery algorithm, greatly increases the spatial resolution
- MISC, a super-fast iterative correction algorithm, improves the accuracy of quantitative analysis
- IGNR, an intelligently image-guided noise reduction technology, improves the signal-to-noise ratio of PET image

Comprehensive low dose control technologies ensure the lowest radiation dose

- Using Scintistar dPET and Scintistar CT high sensitive, low radiation

detectors

- 50 per cent lower dose gains 100 per cent satisfactory image
- imA intelligent dose control technology, iRecon iterative reconstruction, complete scan protocols, comprehensive CT dose management plan

The lowest operating costs ensures the highest return on investment

- ScintCare PET/CT reduces the usage cost at all aspects
- Imaging with low radiation dose saves million of dollars of pharmaceuticals and equipment operating costs every year

High performance imaging system

- Higher system sensitivity to ensure higher SNR.
- Better PET spatial resolution with 1:1 coupling of scintillators to SiPM.
- ScintLaSante software solution to enhance image details and reduce image noise.

Better and pleasant user experience

- Low operation cost with low dose injection, high patient throughput, reduced maintenance cost, and scalable PET modular design.
- Great patient care with optimised PET work flow and intelligent CT imA dose control to ensure minimum radiation dose.
- Synchronise the anatomical centre location in multiple series and compensate for patient displacement between acquisitions.

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SuperVan 1.5T

The new milestone in 1.5T MR imaging



Focussed on excellent performance, SuperVan 1.5T perfectly meets your needs of quantitative study in MRI practice – with new generation of quantitative analysis tools to fulfil precision medicine and latest applications to broaden your clinical scope. With advanced MUSIC technology, it enables fast image acquisition and multiple exams without repositioning.

MUSIC (Multi-Segment Imaging Combination) improves MR imaging with flexibility, precision, and speed. It perfectly integrates a maximum number of 66 channels and provides 16 independent RF channels to be used simultaneously in one single scan and in one FOV. It enhances image quality and acquisition speed to a brand new level.

With MUSIC's body coverage, repositioning patients for multiple exams is no longer necessary.

Flexibility: MUSIC is easy to use with more adaptability and versatility. You only need to choose the examination you want without the coils replacement, which improves workflow and increases productivity.

Precision: With excellent and pinpointed precision, MUSIC provides excellent image quality from small lesions to the whole body.

Speed: With MUSIC, the examination set-up is faster and simpler, and acquisition time is shorter.

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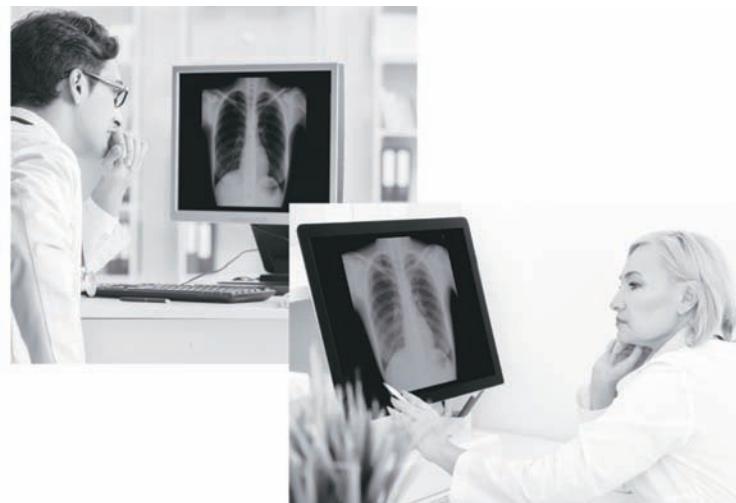
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Are you seeing medical images accurately?

The same medical image data may need to be read by several people to reach a conclusion. If each person is viewing an image slightly differently to another, they're likely to interpret the same image differently

When comparing multiple monitor screens straight from the factory, you may notice subtle differences in colour and brightness. Despite being made all the same, each monitor's screen will be slightly different to another due to current LCD panel technology constraints. For typical office work, variances in brightness and colour aren't usually detrimental, so differences between screens do little harm. Therefore, standard COTS (commercial off-the-shelf) monitors can be an economical choice. However, for more critical applications such as in radiology, subtle discrepancies can make a world of difference. In these settings COTS monitors are not suitable by any means.

In healthcare settings, the same medical image data may need to be read by several people to reach a conclusion. If each person is viewing an image slightly differently to another, they're likely to interpret the same image differently. For example, one doctor may notice a shadow on their image and note it as suspicious, while another doctor may not see the shadow as clearly and note it as unsuspicious. To get accurate results, everyone needs to be on the same page. But what makes a monitor accurate? How do you know if the



monitor you're using is ideal?

To answer this, we first must know what a monitor's greyscale is, and how it is controlled. In every monitor, each pixel changes brightness according to an algorithm. This is called the greyscale. When a bright image is displayed, the pixels will brighten to show a light grey, whereas when a dark image is shown, the pixels will dim to show a dark grey. How much each pixel dims or brightens depends on the greyscale. Although meant to be a gentle curve, if uncalibrated, this greyscale can become distorted due to the natural discrepancies between LCD panels, and deterioration over time. This may lead to some monitors displaying an image with

lots of dark greys, with few bright greys, whereas another monitor may display the same image with lots of light greys, but few dark greys. As you can see in the below image, the same image is displayed, but the visibility of structures differs greatly between them. This is because the left image's greyscale is weighted toward dark greys, whereas the right image is weighted toward light greys.

Despite being the same image, the left is displayed too dark, whereas the right is displayed too light.

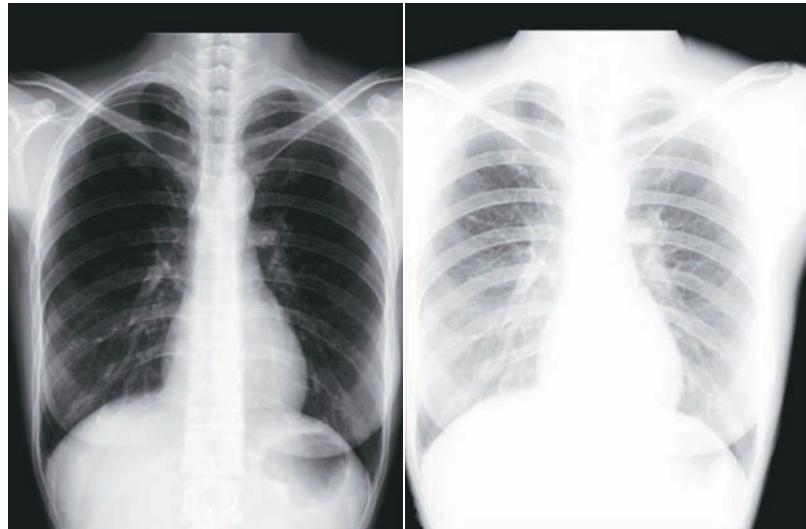
If all medical monitors in a facility display images according to the same greyscale, all images will be seen almost identically. But what greyscale should be

TRADE AND TRENDS

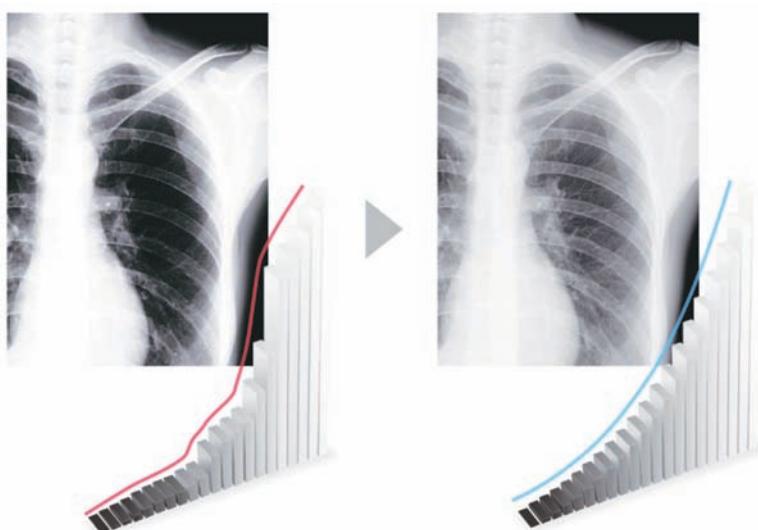
used? This is where something called the DICOM Standard GSDF (Grayscale Standard Display Function), or DICOM Part 14, comes into play. The DICOM (Digital Imaging and Communications in Medicine) Standard is “the international standard to transmit, store, retrieve, print, process, and display medical imaging information.” Within the standard, DICOM has mathematically defined the ideal greyscale that allows for the clearest viewing of medical images. It takes into consideration the contrast sensitivity of the human eye – i.e. that our eyes are more sensitive in dark areas than in bright. Therefore, this greyscale is not a linear scale, but a graded scale to account for the natural sensitivities of our eyes.

Many medical monitors have this greyscale calibrated at the factory and are ready to be used straight from the box. But over time a monitor’s greyscale can drift, meaning that medical monitors must be calibrated regularly to ensure accuracy over time. This calibration is done using specially designed calibration devices and software that are able to reprogram how the monitor displays images. Budget models typically require an external calibrator, which requires the user to physically do the calibration themselves – wasting precious time and resources. However, medical monitors that include internal calibrators can be programmed to run at convenient times – without the user even needing to be present. With regular calibration, all monitors in a facility (or even over multiple facilities) can display images with the same level of accuracy, to ensure consistent results.

To display medical images correctly, and provide an accurate diagnosis to patients, it’s vital to ensure that your



Despite being the same image, the left is displayed too dark, whereas the right is displayed too light



Without DICOM Part 14

medical display device can display images according to the DICOM GSDF – which was made with the human visual system in mind to ensure the best possible way of to view medical images. Not doing so may risk misinterpreting

With DICOM Part 14

medical images, leading to incorrect or late diagnosis. With patients entrusting their lives to doctors, it's the responsibility of all medical professionals to see medical images accurately. Are you seeing medical images accurately?

Carestream's new digital imaging offering receives FDA clearance

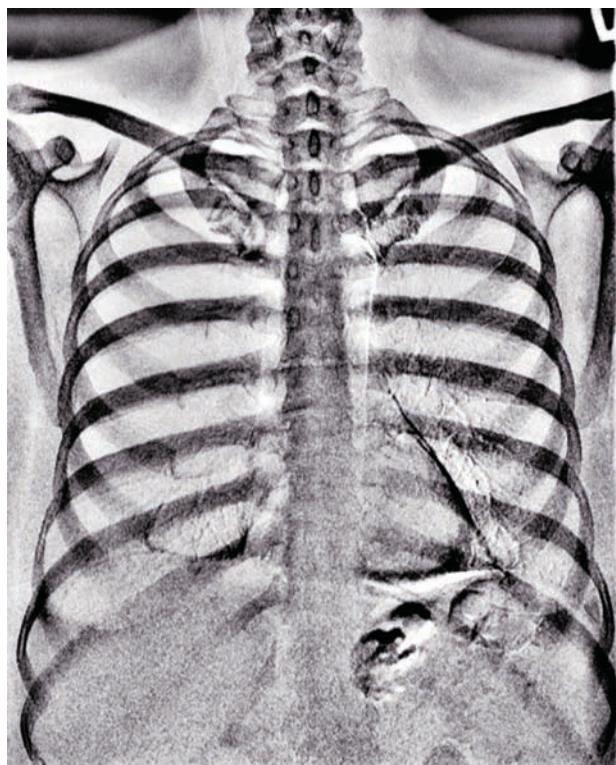
Carestream's Dual-Energy imaging technology and its Focus 35C Detector with Image Suite Software received 510(k) clearance from the US FDA

Carestream's Dual-Energy application—powered by the company's Eclipse image processing engine—utilises two filter materials that are automatically switched between the high- and low-energy exposures to produce a soft-tissue-only image with the bone structures removed, as well as a corresponding bone-only image. This differential filter approach optimises both X-ray spectrums, achieving optimal dose efficiency. It also delivers outstanding image quality—at the equivalent patient exposure as a standard, non-Dual-Energy posterior-anterior chest radiograph.

Carestream's Dual-Energy

technology has been approved for chest X-rays on its DRX-Evolution Plus System.

"When performing a standard chest X-ray, you see both soft tissue and bone structures overlaying on top of each other," said Sarah Verna, Worldwide Marketing Manager, Global X-ray Solutions, Carestream. "Dual-Energy



will help radiologists improve the specificity and sensitivity for chest diagnosis because of both material differentiation and the removal of overlapping anatomical structures."

Dual-Energy technology is another example of Carestream's ability to use algorithmic results to provide better medical image quality and improve

diagnostic capabilities, while keeping patient safety in mind.

"This technology takes two images in rapid succession but when you compare the total entrance skin exposure to the patient, it's the same as a standard PA chest exam. Dual-Energy does not expose the patient to more radiation," Verna added.

Carestream's new Focus 35C Detector with Image Suite Software offers smaller facilities and speciality practices a budget-friendly way to tap the power of digital medical imaging. This highly economical retrofit solution combines advanced image processing with broad functionality, easily transforming an analog X-ray room into a full wireless

digital radiography system. The Focus 35C Detector paired with Image Suite Software provide a mini picture archiving and communication system (PACS), delivering a complete imaging package so the customer benefits from all the capabilities of a PACS without having to invest in all the features of a larger system.

KONICA Minolta Healthcare India's range of AeroSCAN digital ultrasound

KONICA Minolta Healthcare India with their range of AeroSCAN digital ultrasound caters to various segments in radiology, obstetrics and gynaecology, cardiology, general imaging providing you a range of cost effective and affordable solution in several formats : portable / cart mounted/ battery operated POC – point of care ultrasound machines with choice of high density probes for MSK, anaesthesia, ICU, intraoperative, SNV - simple needle visualisation - needle enhancement biopsy.

Greater confidence in general imaging: AeroSCAN's advanced ultrasound platform provides superb image quality, intuitive user interface and fast scanning response. It provides high image resolution and good penetration. User -friendly interface simplifies daily work-flow. Features like Micro-Scan, Jcompound imaging and panoramic imaging give better precision in imaging practices.

Safeguarding the heart : With high resolution, modern interface and quantification tools help customers for cardiac studies. AeroSCAN range offers extraordinary colour and sensitivity that enhances the user's confidence in cardiac imaging. Features like TVI, TDI and easy Stress Echo workflow help offer the best in cardiac imaging.

Reaching out to every point-of-care (POC): AeroSCAN's premium high density linear probes give users an



indispensable tool for point of care (POC) applications which include study and diagnosis of nerve block, musculoskeletal and rheumatology. A high frequency platform upto 18MHz allows superficial image quality to be perfect and makes workflow quicker as well as easier.

Protecting investments:

- Konica Minolta offers exhaustive radiology solution;
- Digital radiography (DR) – Full Room
- Mobile DR and retrofit DR systems

- Computed radiography (CR) systems with laser imager printers
- Ultrasound machines
- Digital mammography systems with digital breast tomosynthesis (DBT), stereotactic biopsy,
- AeroSCAN power injectors for CT/ DSA/ MRI).

With several installations pan India Konica Minolta's widespread network of service support engineers and application personnel ensures optimised customer reach and maximum equipment availability. Service team ensures quick, flexible and affordable solutions along with upgrade of imaging parameters keeping one updated with the latest imaging techniques.

Konica Minolta offers new award winning AeroSCAN CD35 which provides optimised performance in stylish design and comes equipped with class leading features - Fusion THI 2.0, balance echo compensation, VS flow, new touch screen interface, unique 5Q probe technology that offers increased probe bandwidth and enhances its sensitivity as well as resolution.

Agfa DR 100s: A new force in mobile DR

Agfa's DR 100s is a high-productivity, ergonomic, mobile DR imaging solution. With a customer-driven design that meets the needs of today's healthcare environments, the DR 100s delivers a new force in mobile imaging. It combines agility, excellent DR image quality, fast image preview and a broad range of applications, including chest, abdomen, skeletal and long-length stitching exams, to improve productivity while supporting enhanced patient care.

With its swift motor driven and compact design, the DR 100s offers excellent maneuverability. Its 22.8"/58 cm width and FreeView collapsible telescopic column enable it to be easily moved along crowded corridors and narrow patient care units. Thoughtful features such as the conveniently positioned power plug, storage for necessities (gloves, sanitiser, etc.), an integrated detector battery charger, and security locks on detectors and the remote exposure switch add to the efficiency of the design.

Bedside imaging is comfortable for the operator and patients alike. The tube head with ZeroForce technology makes manual movement nearly effortless in all three axes. The 10" tube head display allows bedside adjustments at the tube head, and gives the operator access to patient data, generator settings and image previews.

The DR 100s is standard equipped with the MUSICA acquisition workstation, which



offers a single, intuitive interface for smooth and efficient imaging, on a 22" inch touchscreen monitor that can be angled to eliminate light reflection. It enables comfortable viewing of image previews and access to a broad range of tools, applications and features.

Smart, customer-driven innovations facilitate flexibility and customisation. Patient data and exposure parameters are

automatically added to the digital image file which naturally reduces the risk of manual errors. All patient exposure data is included in the DICOM information for review.

Agfa's MUSICA acquisition workstation uses managed coding programming frameworks to support a more secure software and offers the latest network protocol supporting built-in security features for a more secure patient record.

AeroJET injector systems by Konica Minolta Healthcare



Konica Minolta Healthcare offers AeroJET range of intravenous, contrast power injector systems which can be used with CT Scanner, MRI System and DSA (Digital subtraction angiography). Our unique direct pressure sensor function protects patients from swelling due to vascular rupture and multiple injection protocol allows the full flexibility of injection choices. AeroJET injectors have been sold over the past 10 years globally which offer a perfect working environment with most manufacturers like GE, Philips, Siemens, Toshiba and Shimadzu.

AeroJET offers a range of products to choose from based on application;

CT injector: AeroJET S (single syringe) and AeroJET D (dual syringe)

MRI injector: AeroJET MRI-A/AP and AeroJET MRI-B/BP

DSA injector: AeroJET Angio 1200

Why Choose AeroJET Injectors?

DSP patent: DSP refers "Direct Pressure Sensor." AeroJET injectors use the patented technology, of Direct Pressure Sensor which allows real-



time monitoring of injection process in details and could effectively prevents the patient from swelling, offering a safe injection experiences.

Large remote console: Besides the standard control on the unit, AeroJET offers a large 12.1" Color LCD touch screen display remote



console. This allows the operator to easily handle the whole injection remotely. With user friendly interface the system gives operator easy to edit protocols and execution of injection, which synchronously display all operations in the local console as well as remote console.

LED indicator:

Unique LED indicator on the injector shows suction and injection process. The continuous glittering design makes the whole process more visible for the operator outside.



Local and remote real colour LCD touch screen display console : Able to edit the protocols and execution of injection, synchronous display of all operations of the local console.

AeroJET power injectors – CT/ MRI/ DSA

For additional information/ quotation please contact :
Konica Minolta Healthcare India Ltd
Tel : 022-61916900;
email : sales@mi.konicaminolta.in

Konica Minolta Healthcare: THE NEXT STANDARD – AeroDR NS flat panel detector

THE NEXT STANDARD of digital radiography – The new choice for digital upgrade. AeroDR NS is the value proposition in the AeroDR series which incorporates all important functionalities for digital upgrades for your X-ray room.

Konica Minolta Healthcare introduces new innovative, affordable THE NEXT STANDARD – AeroDR NS flat panel detector. The AeroDR NS is a ideal solution for medical imaging professionals who are considering to upgrade from Analog or CR to DR on a limited budget.

AeroDR NS – THE NEXT STANDARD

With cutting edge technology and strong focus on robust, user friendly product and excellent image quality, AeroDR is consistently the best-



Shared Wireless Solution

selling flat panel detector in India for the last few years.

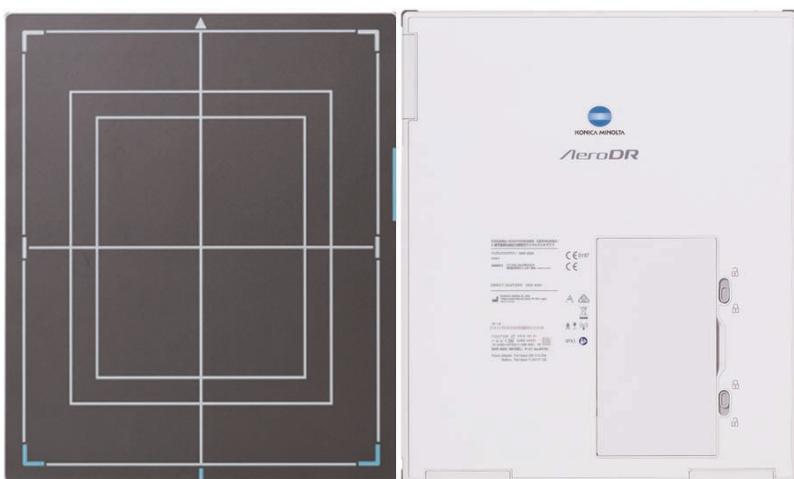
Be it a low powered mobile X-ray or a high powered full room X-ray machine, with the use of the high quality Cesium Iodide Scintillators (CsI) the AeroDR system is capable of producing excellent image quality

as compared to any other flat panel detectors.

AeroDR NS is here to set next standards by improving the productivity and workflow such that a single detector panel can be used with multiple X-ray machines at multiple locations. The AeroDR NS can efficiently be used for ICU's, trauma cases and bed-side X-rays. The biggest advantage of using AeroDR NS instead of a CR workflow is that the acquisition cycle time will be much shorter from several minutes to a few seconds.

Storage on the detector:

An built-in memory storage allows you to take multiple images without a computer connection, just like you were to be used with CR. This Aero Storage functionality can store up to 200 images with the ability to be later retrieved on the console station.



Our aim is to generate double digit growth by 2020

Chandrashekhar Sibal, EVP & Head Medical Division, Fujifilm India in an interaction with Express Radiology, talks about the solutions offered by Fujifilm which will ensure that challenges in the public health sector and population health management are addressed efficiently

Can you throw some light on your recent collaboration with Max Healthcare? What is the major objective behind this partnership?

Breast cancer is still the most common cancer among women globally and in India as well. According to the Health Ministry of India breast cancer ranks as the number one cancer among Indian females with a rate as high as 25.8 per 100,000 women and mortality of 12.7 per 100,000 women. Majority of breast cancer cases in India are detected in young, premenopausal women. It is prevalent in females who are in their early 30s owing to sedentary lifestyles, genetics, dietary changes and family history of cancer.

Witnessing the scarcity of radiologists and limited experts in breast cancer diagnostics across India, Fujifilm India and Max Super Speciality Hospital, Saket have come together with an aim to train doctors in Advance Diagnostics and spread awareness about early detection of breast cancer.

As part of the association, Fujifilm will be sponsoring an Advanced Fellowship in Breast Imaging with Max Healthcare Hospital under the guidance of Dr Bharat Aggarwal, Director – Radiology Services, Max Super Speciality Hospital, Saket and



Dr Harit Chaturvedi, Chairman, Max Institute of Cancer Care.

Under this, Max Fujifilm fellowship Doctors would be trained in breast mammography, breast MR, and breast ultrasound techniques for six months. Each year, the programme will train two select radiologists in the early detection of breast cancer.

This is the first such collaboration of Fujifilm. Can you elaborate on the company's future expansion and collaboration plans on this platform?

(Production facilities in healthcare sector they will set up in India including R&D and training centres) With over 80 years of experience, Fujifilm has been a pioneer in imaging technology and has constantly displayed an innovative line-up of products and solutions. We at Fujifilm believe in collaborative innovation in order to provide solutions for the issues that affect society.

This year, we announced partnerships with Indian Academy of CT-Guided Intervention (IACTI) and Breast Imaging Society of India (BISI) wherein we organised an awareness program on 'Breast & Gynaecology Imaging'; we installed Fujifilm's SYNAPSE technology at Peerless Hospital, Kolkata; organised an awareness programme on 'TOGETHER END TB' with Yashoda Super Speciality Hospital, Kaushambi, Ghaziabad to help eradicate tuberculosis in India; we also offered free chest X-Rays at Chhatrapati Shivaji Subharti Hospital, Meerut, Uttar Pradesh and with Max Healthcare we associated for providing advanced screening of stage 'Zero' breast cancers & are currently running a fellowship-training programme for doctors and radiologists at Max hospital on usage of 'Fujifilm 50 Micron

Digital Mammography Machine.

Living up to our motto of Value from Innovation, we are committed to providing products and services that not only enhance image quality and workflow but also keep the patients well-being in mind by introducing the latest innovative technologies and solutions.

We have developed Computed Radiology and Digital Radiology products which facilitate digitisation of X-ray, coupled with PACS and RIS to provide faster access to images to consultants sitting in metro cities or big hospitals. With more than 30,000 thousand systems installed in India, Fujifilm's focus is on AI and IT.

Through public-private partnerships in India, Fujifilm has installed 100-200 systems across states, in collaboration with the government. We have acquired 94 per cent institutional sales in the public health sector and are looking at expansion in Maharashtra, Madhya Pradesh, Chhattisgarh and Odisha.

We're bringing many solutions, which will ensure that challenges in the public health sector and population health management are addressed efficiently. Hence, it requires a lot of effort in terms of research to get there.

What are your investment plans in the coming years for the Indian market?

During FY2018-19, we recorded a turnover of Rs 1150 crore out of which Medical Systems was the major contributor followed by Photo Imaging, Electronic Imaging, Graphic Arts, Recording Media and Industrial Products respectively. In 1983, Fujifilm started the first digital radiograph and since then it has grown by leaps and bounds when it comes to image

processing, virtual grid technologies and other technologies that have come to the fore with different dynamic ranges.

We have recently won the 'Indian Digital Radiography Company of the Year' award at the Frost & Sullivan 2019 India Best Practices ceremony. This award certainly reaffirms our vision and strengthens our position in the digital radiology space. It resonates with our commitment to provide best-in-class healthcare technologies and diagnostic needs.

With the domestic digital radiography industry touching Rs 162 crore annually, Fujifilm currently shares 30 per cent of the total. We are trying to increase our share in the digital radiography segment from the present 30 per cent and have a target of touching the 40 per cent mark this year. Our aim is to generate more than double revenues by 2020, citing the huge demand for our digital medical devices.

What are the major challenges that the Indian diagnostic market is facing? (Major gaps and need of the hour?)

The overall healthcare industry is undergoing a paradigm shift, evolving from a human-driven to a technology-enabled sector. With this digital transformation, it is bringing a change in the way doctors and patients are interacting.

The major challenge faced by the industry is the scarcity of radiologists and limited experts. While there is enough capital available for the right idea, limited experts in the field is the prime constraint.

We have taken this challenge by introducing technological advancements that help doctors to

manage workflow systems and allow them to treat patients efficiently.

With the increasing incidence of breast cancer diseases in female population, it is imperative for healthcare providers to step up and provide women the best and precise early detection screening facilities that can help save lives. To fight this battle against cancer, it is important to spread awareness and encourage people to undergo regular health check-ups. Understanding the importance of timely screening for prevention is critical towards early diagnosis and treatment, staying true to create awareness for the cause, Fujifilm has been making concerted efforts to contribute to the early detection and treatment of breast cancer through their associating with the Pink Ribbon Campaign. The company's revolutionary techniques and wealth of experience have enabled them to come up with high precision and high-resolution mammography devices. Modern day digital mammography machines with tomosynthesis technology that is available in Fujifilm's 50 Micron digital Mammography - Amulet Innovality is a key device, which helps in detecting the early symptoms of cancer.

Fujifilm's holistic and comprehensive approach in improving women healthcare with digital mammography has driven more than 3,500 happy users across the world, amongst them 40 installations are present in India. The company has collaborated with different institutes all over India for the installation of its 50 Micron 3D Mammography machine - a highly advanced breast cancer diagnostic machine that has made early detection of breast cancer a reality for women.

New ultrasound scan uses laser instead of acoustics to image human body

As part of the study, the researchers sent light in the form of a pulsed laser at a particular wavelength, which penetrates the skin and is absorbed by blood vessels

Researchers have developed an eye- and skin-safe laser system as an alternative to conventional ultrasound, an advance that lead to a new less-invasive imaging technique for seeing the inside of patients.

The scientists, including those from Massachusetts Institute of Technology (MIT) in the US, said conventional ultrasound instruments required contact with a patient's body, limiting its use in patients who don't tolerate the probe well, such as babies, burn victims, or those with sensitive skin.

In their current study, published in the journal *Light: Science and Applications*, the researchers described the first laser ultrasound images in humans.

The forearms of several volunteers were scanned and common tissue features such as muscle, fat, and bone, down to about six centimeters below the skin were observed. These images, the study noted, were produced using remote lasers focussed on a volunteer from half a metre away, and were similar to conventional ultrasound. "We're at the beginning of what we could do with laser ultrasound," said Brian W Anthony, a senior author on the paper from MIT.

"Imagine we get to a point where we



can do everything ultrasound can do now, but at a distance. This gives you a whole new way of seeing organs inside the body and determining properties of deep tissue, without making contact with the patient," Anthony explained.

As part of the study, the researchers sent light in the form of a pulsed laser at a particular wavelength, which penetrates the skin and is absorbed by blood vessels. On getting heated by the laser, the blood vessels rapidly expanded and relaxed, cooling back to their original size -- only to be struck again by another light pulse.

The resulting mechanical vibrations generated sound waves which travelled back up, where they could be detected by signal converters placed on the skin, and translated into an image.

However, the researchers said, the technique still requires a detector in direct contact with the body in order to pick up the sound waves.

They said until now the light can only

travel a short distance into the skin before fading away, meaning the technique could be used to image blood vessels just beneath the skin, but not much deeper.

To overcome this hurdle, the team selected lasers which emitted light at a wavelength absorbed highly by water -- and is eye- and skin-safe with a large safety margin.

Since the human skin is essentially composed of water, the team reasoned that it would efficiently absorb this light, and heat up and expand in response.

As the skin oscillates back to its normal state, it may produce sound waves that propagate through the body, the researchers said.

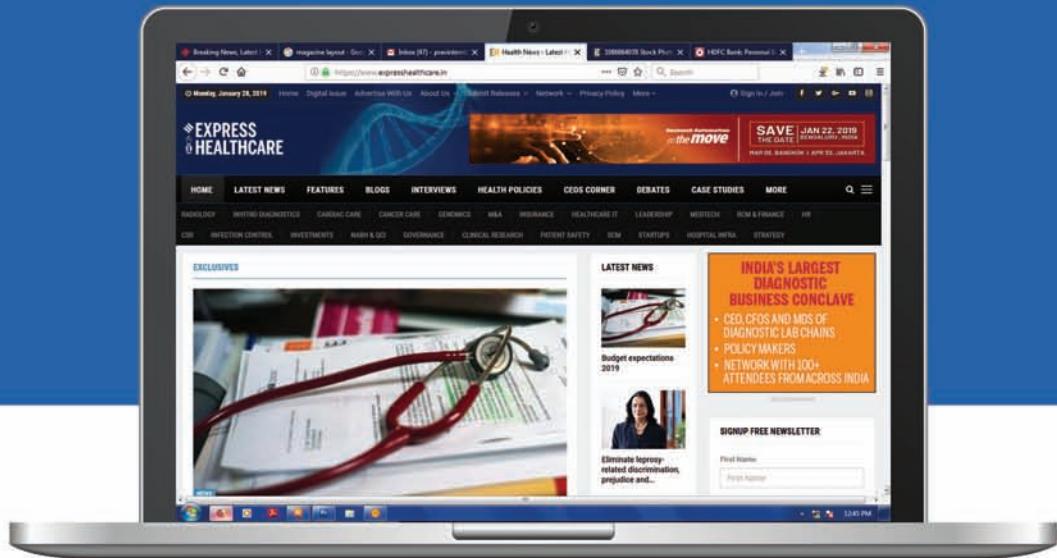
One pulsed laser set at 1,550 nanometers to generate sound waves was then used, and a second continuous laser, tuned to the same wavelength, to remotely detect reflected sound waves.

This second laser, the scientists noted, is a sensitive motion detector that measures vibrations on the skin surface caused by the sound waves bouncing off muscle, fat, and other tissues. They said the laser's frequency changes the skin surface motion generated by the reflected sound waves in a measurable way.

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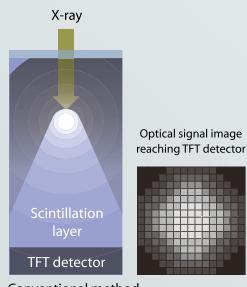
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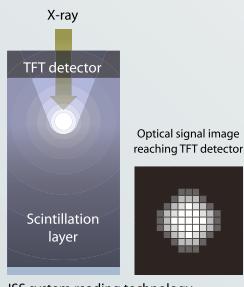
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