

#PrecisionMedicine

From proton therapy in the post-Soviet region to the future of nuclear medicine globally

#CareDelivery

From Denmark's first CT Innovation Unit to the multidisciplinary usage of an angiography system in Turkey

#PatientExperience

From patient-friendly MRI scans in Switzerland to a stand-alone IR department in Belgium

#DigitalHealth

From an open environment for healthcare stakeholders to the changing role of radiologists

# Medical Solutions

The Magazine for Healthcare Leadership

## Strategic Innovation in Healthcare

Meet Rasu Shrestha, an expert in turning innovation into value



RSNA Edition 2018

**SIEMENS**  
Healthineers

*“Innovation isn’t about adding more bells and whistles. It’s about making the tools we design as simple as possible. Innovation, if done right, makes technology invisible.”*

**Rasu Shrestha, MD, MBA**

Read the whole interview on [page 6](#)

# Joint Excellence for Shaping the Future of Healthcare

With our initial public offering in the spring, we concluded one of the biggest changes in our company's history. This move gives us greater flexibility so we can even better and faster tackle new challenges and seize new opportunities in the market. Digitalization offers a great – if not *the* greatest – opportunity for our industry, and is a key lever for transforming care delivery, improving patient experience, and expanding precision medicine. And in the age of digitalization, change will never again be as slow as it used to be.

Just as we have demonstrated our excellence for over 120 years by always striving for the best solutions, this will be all the more true for the future. Our mission is to work together with you to increase value in healthcare.

For this issue of *Medical Solutions*, we've invited renowned healthcare professionals and thought leaders to share their stories, experiences, and expertise with us. They exemplify how our solutions help them be even more successful. We particularly recommend the interview with thought leader Rasu Shrestha, our cover story. He believes healthcare will be ever more pervasive in people's lives. This growing awareness of healthcare offers our customers and us a great opportunity to play an even more active role in the market.

Siemens Healthineers is the right partner at your side as we move forward! We look forward to proving our excellence to you every day.

I wish you an interesting and informative read.



  
**Dr. Bernd Montag,**  
Chief Executive Officer,  
Siemens Healthineers



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A *Medical Solutions* exclusive interview with Rasu Shrestha, MD, MBA, Chief Innovation Officer at the University of Pittsburgh Medical Center and global thought leader.

## #PrecisionMedicine

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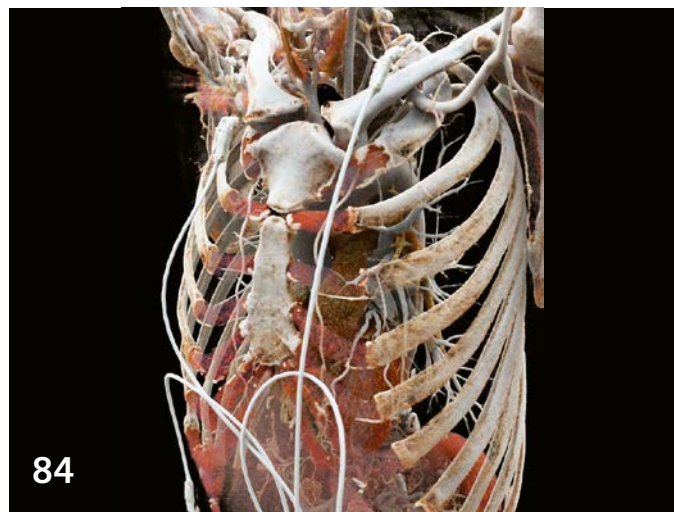
Digital technologies are changing the way radiologists work, bringing with them new challenges, responsibilities, and opportunities.

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Photos: Frank Walsh, Jan Sondergaard, Philip Frohwein





Widely regarded as one of the world's leading experts on strategic innovation in healthcare, **Rasu Shrestha**, MD, MBA, has pursued his career across multiple continents and a diverse range of disciplines. As the Chief Innovation Officer for the University of Pittsburgh Medical Center (UPMC), he discusses the shift toward more participatory healthcare in an exclusive interview with American medical writer Peter Jaret. "Patients have already checked out Dr. Google before they see a Dr. Shrestha," says the renowned doctor.

# Delivering on the Promise of Healthcare Innovation

Interview: Peter Jaret | Photos: Frank Walsh

**H**oused in the historic former Nabisco bakery in Pittsburgh, UPMC Enterprises promotes strategic partnerships, joint development agreements, and investments in healthcare startups, while working with clinical partners throughout UPMC, a 19 billion USD provider-payer that includes more than 40 hospitals and 3.4 million insurance members. In September, while programmers hunched over glowing monitors and strategists plotted out new initiatives on whiteboards in sunlit conference rooms, Dr. Shrestha sat down to share his thoughts on the best practices for nurturing and implementing innovative technologies.

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## Rasu Shrestha, MD, MBA, CIO

Chief Innovation Officer for the University of Pittsburgh Medical Center (UPMC), Rasu Shrestha, MD, was recently named one of the 26 “Smartest People in Health IT” by Becker’s Hospital Review and one of the “Top 20 Health IT Leaders Driving Change” by InformationWeek.

Shrestha serves as the Executive Vice President of UPMC Enterprises, which seeks to develop and commercialize innovative healthcare technologies. A radiologist by training, he has been the chair of the Informatics Scientific Program Committee at the Radiological Society of North America (RSNA). In March 2018, the U.S. Department of Veterans Affairs announced that Shrestha will lead its efforts around interoperability and to push the boundaries of open application programming interfaces (APIs). In addition, he is co-chair of Health Datapalooza, an annual conference that brings together experts from the public, policy, and private sectors to discuss the future of health data and its role in supporting healthcare transformation.

Wearing many hats, Shrestha brings his far-reaching expertise in medicine, radiology, informatics, business strategy, entrepreneurialism, and technology design to bear on a single all-embracing goal: Using strategic innovation to improve the quality and control the cost of healthcare.

## How did you first become interested in healthcare innovation?

My specialty is radiology, which set the pace for the industry early on in moving from analog to digital and in developing picture archiving and communications systems (PACS). Radiology has also been a leader in using algorithms and AI to support diagnostic decision-making. So I guess I’ve always been interested in innovation. Today, of course, across the healthcare spectrum, technological innovation holds out the promise of really transforming the practice of medicine for the better.

## What are the biggest challenges?

Healthcare is littered with challenges. I mean, if you’re a sucker for a challenge, come to healthcare, right? One is the sheer complexity of healthcare. There’s the complexity of medical research. The complexity of the healthcare system we’ve created. The complexity of human beings – not just our biology, but our behavior and what drives behavioral change. Unfortunately, some of the technologies in healthcare today only add to that complexity. So one of our starting points is to recognize that innovation isn’t about adding more bells and whistles. It’s about making the tools we design as simple as possible.

Another challenge is a clash of cultures between healthcare providers and innovators. In healthcare, in large part for the right reasons, we resist change. That’s what evidence-based guidelines, clinical protocols, best practices are all based on: Let’s test to see what works and stick with it. We’re slow to change because making a mistake in healthcare can be a matter of life or death. Innovators, on the other hand, want to disrupt things. Innovators say, “hey here’s a brand new way of doing things. Trust us, it will work.” There’s an inherent clash between those cultures. We’re trying to find ways to bridge these cultural differences by embracing the core value of design thinking so that we can approach the challenge of culture clash in a radically pragmatic way.

## How do you encourage these people with very different perspectives to work together?

We ask ourselves and the people we work with to understand the perspectives of the other people involved. We don’t necessarily start with the pain points. And we definitely don’t start by jumping straight to the solutions. We start with empathy. We involve the key stakeholders in the conversation right from the beginning, and we keep them engaged in an iterative process. The goal isn’t to






develop a fully fledged product for the enduser right from the start. We're not running a marathon. We're doing short sprints of development, where we have the opportunity to fail fast, but scale successes. That way, we get active feedback, rapid iterative cycles that encourage the right type of innovation to bubble up to the top.

We also choose partners – innovators, entrepreneurs, collaborators, and team members – with a real passion and determination to make meaningful changes. It takes a special breed of doers and believers to make change happen and to scale it up, to make it sticky. We're not interested in some sexy-sounding new technology just because it's cool or the latest thing. We look for strategic alignments that will allow us to make a real difference in the quality, efficiency, and cost of healthcare.

**Where do you see innovation making the biggest difference, in terms of better outcomes at lower cost?**

There are multiple wedges that the hammer of innovation can strike. I want to mention here that we're ideally positioned to nurture innovation at UPMC. We're an integrated delivery network, which means we provide coverage through our health plan, and we provide healthcare services through our provider network. We make sure that the incentives to provide value and control costs are aligned to make the right decision not just for the patient but also for the healthcare plan member. We think of UPMC as a living laboratory. Our model is not just patient-centric but really a person-centric approach to care, which is a different perspective altogether. The goal is to keep people out of the hospital, to cut costs by keeping people well.

Go to [siemens-healthineers.com/shreshtha](https://siemens-healthineers.com/shreshtha) for exclusive video excerpts of the interview with Dr. Shreshtha.



*"Healthcare will be more pervasive  
in people's lives because it will  
be focused on keeping people within  
the magic circle of wellness, not just  
treating them when they're sick."*

Rasu Shrestha, MD, MBA

One of the things we're focusing on is the delivery process itself, looking for ways to squeeze out costs that shouldn't be there in the first place. We're also looking for ways to intelligently bring together data that's often locked away in silos of information systems throughout the healthcare infrastructure. Let me give you an example in radiology. When a patient comes in who has had a whack to the head, a busy emergency department doctor routinely orders head and neck imaging tests. It's routine. And it's also expensive. We have a lot of data out there that could help a doctor decide when imaging is appropriate and necessary and when it's not. We need better ways to make that data quickly and easily accessible.

Another example are chronically ill patients. Too often, they're seen in the hospital, discharged, and before long they're back in the hospital. In a new initiative at UPMC, we're discharging patients with not just a bag of pills and a discharge summary but with wearable devices and other technologies that allow us to monitor their condition – with their permission, of course. There's a lot of data being pulled into an intelligent data hub, which enables us to monitor chronically ill patients and recognize when things are starting to go wrong, so we can intervene before they have a crisis and end up in the ED. We improve care and cut costs.

### **How will precision medicine fit into the future of healthcare?**

Increasingly, we can look at genotypic data, phenotypic data, imaging data and medical records. We can get insights into biomarkers and receptors, predispositions for certain diseases or side effects, and feed it all into clinical decision-making. We can personalize care for that “n of 1,” meaning the individual patient in front of you. At the other end of the spectrum is population health, or the “n of many.” With big data, we're learning more about what certain populations of people have in common – people with diabetes, for instance, or congestive heart failure, or populations that have both diabetes and congestive heart failure. You can learn a lot about patients just by looking at their zip codes, which may be an even stronger determinant of health outcomes than genetic codes. Data about where people eat, work, live, and play is important because it's the data that will affect behavior change and health habits. One of our strategies at UPMC is to find the right balance between precision medicine and population medicine, make the best and most precise decision for that “n of 1” who also happens to be an “n of many.”

### **How will innovation transform a patient's experience of healthcare?**

Increasingly, healthcare will be less about treating a specific episode of illness and more about promoting well-being. Healthcare will be more pervasive in people's lives because it will be focused on keeping people within the magic circle of wellness, not just treating them when they're sick.

The relationship between patients and physicians will also change. Medicine has always been traditionally very paternalistic. Patients went to the doctor expecting the doctor to tell them what needs to be done, to order tests, to give them medications. We're already seeing a shift toward more participatory care. They're more aware, more engaged, they're leaning in. One of the goals of innovation must be to capitalize on that engagement and empower these people to take charge of their health. It's not just a matter of giving people access to their health data. It also means giving them the tools and capability to make the data useful and meaningful to them, in their circumstances, and to their preferences and drives.

### **The practice of medicine is also being transformed, and change can be threatening. What's your message to the next generation of doctors?**

The fear out there is that “AI is coming, so run for the hills!” I don't think that's how we should think about it. Instead of artificial intelligence, we should call it “augmented intelligence.” Designed and used wisely, emerging technologies like AI will enable doctors do what they do best – and what they truly want to do best, which is to care for patients.

AI is really good at data crunching. It's really good at looking at multiple different data points – not just two or three or four but tens of thousands, parallel processed at the same time, something we humans can't do. AI will be a powerful diagnostic tool for doctors. If managed right, it will make us smarter and give us the space to nurture trust, a sense of community, and a sense of collaboration with our patients. The role of doctors and nurses as communicators and counselors will become more important than ever. We'll have the opportunity to practice much more holistically, to get to know our patients better, not just when they're sick but, just as importantly, when they're well. I think healthcare providers will be much more involved in innovation, in helping to shape the technologies so they provide real value. ●

#### **Author:**

**Peter Jaret** is a frequent contributor to the *New York Times* and other publications. He is the author of several books, including *Nurse: A World of Care* (Emory Press) and *Impact: From the Frontlines of Global Health* (National Geographic).

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UMCG installed the  
world's very first  
next-generation PET/CT:  
Biograph Vision.

# A New Era of Nuclear Medicine

Three nuclear medicine professionals reflect on the history of the field and how technology, over the course of 60 years, has helped shape nuclear medicine. Through their experiences, they offer insights into where they think the latest innovations will take nuclear medicine.

Text: Joseph J. Diorio | Site photography courtesy of Siemens Healthineers, CHUV, and UMCG  
xSPECT Quant photos by Alex Teuscher

**H**indsight is always 20/20, or so goes the saying. Looking back we are able to see past events far more clearly, and the history of nuclear medicine is no exception. We can look back and reflect on the milestones and achievements that comprise the rich history of the science. Yet, in hindsight, something that was less clear were the images that came from early efforts in the technology.

“Although the function of the organs was exquisitely measured by nuclear medicine, you had to have a little bit of faith about the morphology when you looked at an image and wondered, ‘well, is that the shape of a lung, is that the shape of a myocardium, is that the shape of a liver?’” reminisces John Prior, PhD, MD, FEB-NM, Head of Nuclear Medicine at Centre Hospitalier Universitaire Vaudois (CHUV) in Lausanne, Switzerland. To summarize his experiences in the

early 1990s, Professor Prior states: “What we were doing back then was sometimes more of an art than a science. You had to have faith in the images you were seeing.”

Over the years nuclear medicine progressed, and what continues to

fascinate Prior is, “the ability to really understand the disease and to be able to bring, if you will, the latest technological advances forward to take care of patients.”

For Ronald Boellaard, PhD, medical physicist at the University Medical

With xSPECT Quant, CHUV team members are able to quantify their SPECT/CT images.







At UMCG, the installation of Biograph Vision prepares them for the next era in imaging.

Center Groningen (UMCG) in the Netherlands – and an 18-year veteran in the field – the effects of technological advancements within nuclear medicine are also notable. “Today, you can see a huge difference in image quality, lesion detectability, and the impacts on diagnosis of patients compared with years ago,” he states. Such progress has a profound effect on the quest to deliver the best patient care.

## The culmination of innovation

Technological advances reside at the core of nuclear medicine, spanning a time from when systems first detected tracers administered to patients to today’s multifunctional tracers used for quantitative analysis. Technology’s benefits to nuclear medicine continue to evolve, even now as the field celebrates 60 years of the gamma camera and 20 years since the introduction of PET/CT.

As physicians strive to enhance patient care, manufacturers continue to work and produce technologies that define innovations within nuclear medicine. For physicians at CHUV and UMCG, the utilization of such innovations impact their clinical decisions today.

## Quantifying nuclear medicine

“SPECT quantification has been around for a long time in nuclear medicine,” Prior says. “In the beginning, we were basically trying to perform quantification with regular nuclear medicine every time we did dosimetry studies, but that was very cumbersome.”

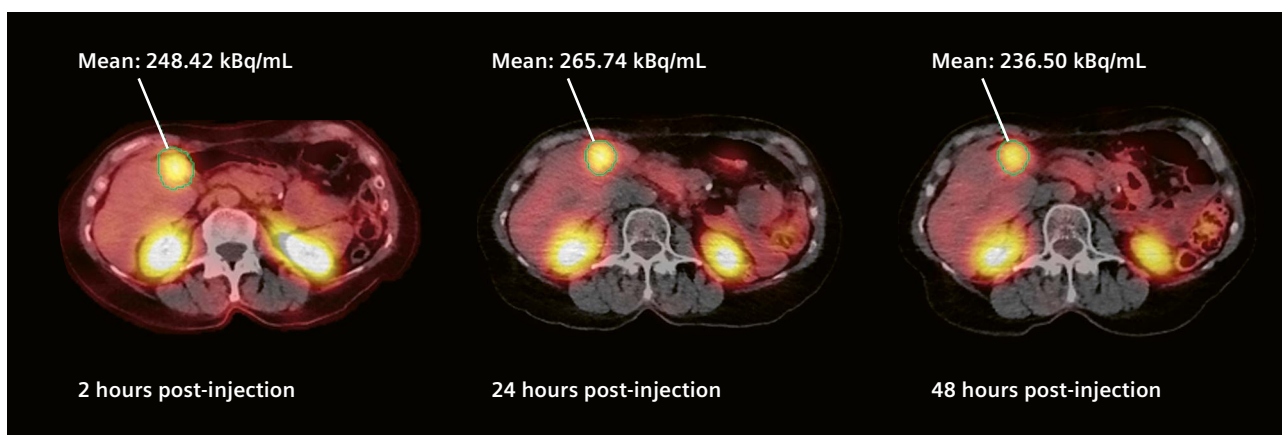
Needless to say, implementing a cumbersome quantitative approach to SPECT/CT in a busy, daily workflow was a challenge. With xSPECT Quant, Professor Prior and his team now have access to a technology that enables

them to incorporate automated quantification in their daily workflow.

“When we saw that a manufacturer had the possibility to deliver something that could be intrinsically calibrated, this gave us a lot of hope for quantitative SPECT/CT. The more quantitative we can be, the higher resolution and sensitivity we can have, the better,” summarizes Prior. “We can now precisely quantitate how much of the radiopharmaceutical that we administer to the patient ends up in a given organ. Siemens Healthineers was the first one with this tool. We are currently working with a range of isotopes – Iodine-123, Lutetium-177, Indium-111, and Technetium-99m – and we can quantify things we could only see before.”

He further explains that the technology enables physicians to obtain an absolute quantitative value. “We do not need to make a ratio. And





Following peptide receptor radionuclide therapy (PRRT) for metastatic neuroendocrine tumor with  $^{177}\text{Lu}$  DOTATATE, sequential SPECT/CT images were acquired. With xSPECT Quant, total lesional concentration of the therapy dose can be calculated and tracked over time. This enables dosimetric evaluation of tumor dose (as in this case) or assessment of therapeutic response following multiple treatment cycles.

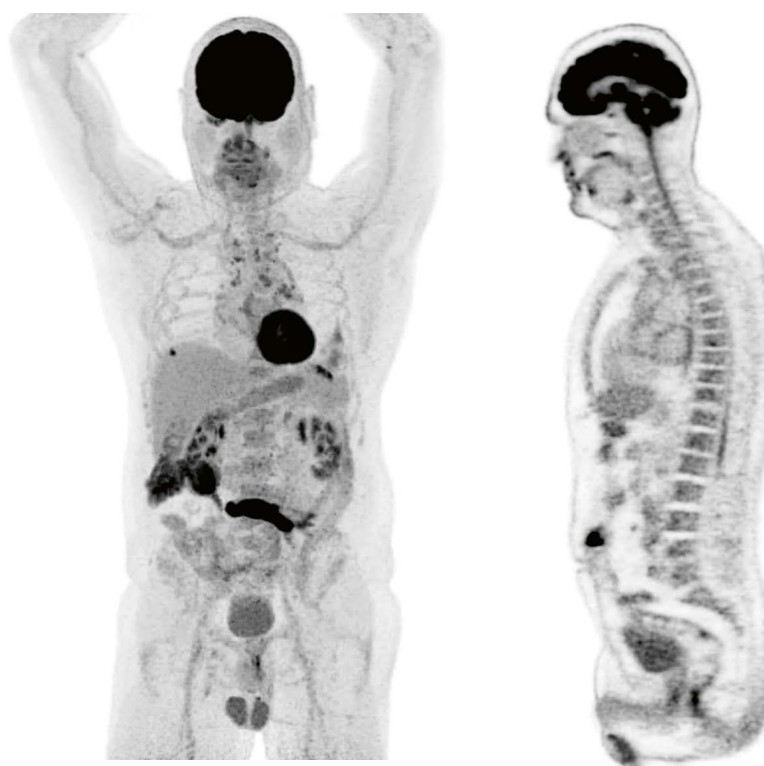
Data courtesy of CHUV, Lausanne, Switzerland. The patient was scanned with a Symbia Intevo™ SPECT/CT, 170 mCi [ $^{177}\text{Lu}$  DOTATATE; 2-, 24-, and 48-hour post-injection delay. CT: 130 kV, 30 mAs.

because of that, we thought, 'this is interesting and maybe we can catch disease earlier with this.' With these radiotracers, we can follow the pathology; we can detect a disease in a more efficient way since we have an absolute, quantifiable value," Prior concludes.

## Delivering precision

Automated quantification in SPECT/CT is more than a clinical breakthrough – it enables precision. Prior emphasizes the benefit that quantification adds to SPECT/CT: "It's bringing a little bit more precision to what we call precision medicine."

While SPECT/CT looks to quantification as its gateway to precision, PET/CT looks to the latest advancements in scanner technology to bring precision to molecular imaging. UMCG, an institution that wants to harness the latest advancements in PET/CT imaging capabilities, recently installed the world's very first Biograph Vision. Discussing the initial appeal of the system, Professor Boellaard explains: "We were interested in working with the new technology, not only because we could see more patients a day, but also because of the expected improvement in image quality as a



PET MIP

Sagittal

The images showed sharp delineation of small hypermetabolic metastases in the right lobe of liver near the dome of the diaphragm (Segment VII). Intense uptake in the abdominal wall is suggestive of metastatic deposit. Mildly increased uptake in mediastinal lymph nodes are possibly secondary to inflammation. High contrast of small liver metastases without significant motion-related blurring even without respiratory gating reflects high overall image quality and increased lesion contrast to background in the Biograph Vision images.

Data courtesy of UMCG, Groningen, The Netherlands. The patient was scanned with a Biograph Vision, 1 hour 50 minutes post-injection delay. CT: 100 kV, 10 eff mAs., 32 × 1.2 mm collimation. PET: 7 beds, 3 minutes/bed, 440 × 440 matrix.

result of the excellent time-of-flight performance. We envisioned that we could get more accurate image quantification and an improved image quality.”<sup>1</sup>

Installed in May 2018, Biograph Vision was able to quickly meet these expectations at UMCG. Echoing Boellaard’s comment on the appeal of the new scanner, Walter Noordzij, PhD, MD, a nuclear physician at UMCG, reveals his first clinical impressions: “There is a potential in better discriminating lesions from physiological background activity. And maybe upstaging your patients from, let’s say, uncertain to the presence of a disease.”

Dr. Noordzij further stresses the significance of technological advancements as physicians move toward personalized medicine. “It’s becoming very important for us, even more so nowadays since we know more about the disease and the heterogeneity of tumors and their metastases.”

## Making a difference

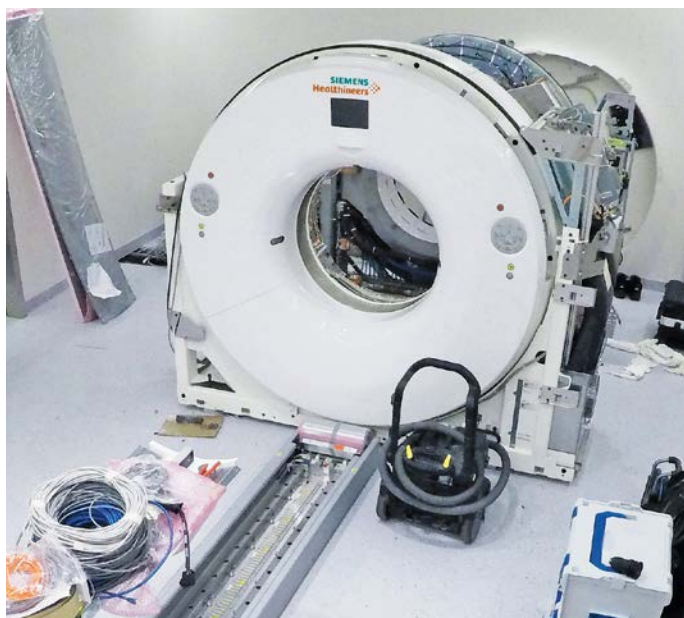
The ability to be precise, as the field strives to contribute to personalized medicine, is paramount.

At CHUV, while Prior works to bring quantification and precision to SPECT/CT, he can also bring the most current innovations in PET/CT to his patients,

as CHUV recently installed the world’s second Biograph Vision. “I’m really lucky to be at a center where our oncologists are so interested in molecular imaging. With xSPECT Quant and Biograph Vision, it’s really helping us push the technology that best serves our patients,” Prior emphasizes.

At UMCG, Biograph Vision will be the third PET/CT scanner, allowing them to significantly increase the number of scans they can perform – the organization topped 4,000 scans in 2017. Noordzij discusses how the additional capacity will enable the implementation of more clinical, as well as research-focused, PET/CT scans. “On the one hand, we’ve seen an increase in the demand for clinical PET/CT scans over the past five to six years. On the other hand, there’s an enormous demand for research in PET/CT and it’s pretty easy to say the addition of the Biograph Vision scanner will help us meet this need.”

The robust history and technological innovations of the past 60 years are a significant testament to nuclear medicine’s progress. Given the recent development of groundbreaking technologies, it’s apparent that the future looks a lot clearer than the past. ●



With the installation of Biograph Vision, CHUV is able to deliver precision.

<sup>1</sup> Compared with current systems.

The statements by Siemens Healthineers customers described herein are based on results that were achieved in the customer’s unique setting. Since there is no “typical” hospital and many variables exist (e.g., hospital size, case mix, level of IT adoption) there can be no guarantee that other customers will achieve the same results.

xSPECT Quant and Biograph Vision are not commercially available in some countries. Due to regulatory reasons, their future availability cannot be guaranteed. Please contact your local Siemens Healthineers organization for further details.



For a number of years, lecturer Ralph Nawrotzki, MD, DPhil, has been working with tutors to further develop the preclinical ultrasound course.

## Fresh Approaches to Ultrasound Education

Heidelberg University is one of the few German universities to offer all medical students the opportunity to acquire and consolidate knowledge of abdominal ultrasound and topographical anatomy at the preclinical stage. The one-week program has received the best evaluation of all courses at Heidelberg University.



**A**s omnipresent and indispensable ultrasound is in medical practice, still there are very few opportunities for students to familiarize themselves with this procedure at an early stage in their studies. One pioneering institution in the provision of broad-based ultrasound training, even in the preclinical semesters, is Heidelberg University. Here, all students of human medicine can attend a five-day ultrasound course in the second semester to consolidate their basic anatomical knowledge from the dissection course while simultaneously gaining their first practical experience with ultrasound.

### Imaging anatomy

The course's success shows that the curriculum developers are on the right track: Attracting over 300 participants each year, it is the best-evaluated course at Heidelberg University. At the same time, the concept of teaching anatomy using

peer students is also exactly in line with the 2020 master plan for medical education ("Masterplan Medizinstudium 2020"), in which the German government's expert commission has called for a stronger focus on clinically relevant content. For Ralph Nawrotzki, MD, DPhil, educational coordinator of the preclinical studies section at Heidelberg University's Institute for Anatomy and Cell Biology, the learning spiral that the course provides is a key factor in its success: "Normally, it's difficult to give students an idea of the neighborhood relationships in the abdominal region, for example. Now, we can lay the foundations for this in normal macroscopic teaching in the first semester and then consolidate them in the ultrasound course in a way that's actually relevant to practical diagnostics. This acts as a source of huge intrinsic motivation for the students." Another key factor is the role played by the course's team of around 50 tutors, who are selected and trained based on an elaborate system. In this way, the anatomists in Heidelberg not only ensure that the basics of ultrasound diagnostics are conveyed to a large number of students, but also simultaneously train a broad group of highly motivated ultrasound operators for the future.

### Teaching pattern recognition

Nawrotzki emphasizes that the course complements the classical learning objectives of anatomical systematics by providing students with training in pattern recognition: "This is about a physician's basic ability to differentiate: 'What is a normal, common occurrence and what could be pathological, in which case I need to discuss it with someone more experienced.'" It is a testament to the course's credibility that, for the last three years, students from top European universities have attended an international summer course (SASH) in Heidelberg in order to train based on the same model.

Heidelberg University's Study Commission and its student representatives were so convinced of the value of the ultrasound courses that they

*"Normally, it's difficult to give students an idea of the neighborhood relationships in the abdominal region, for example. Now, we can lay the foundations for this in normal macroscopic classes in the first semester and then consolidate them in the ultrasound course in a way that's actually relevant to practical diagnostics."*

Ralph Nawrotzki, MD, DPhil  
Educational coordinator of the preclinical studies section  
and lecturer at Heidelberg University's Institute for  
Anatomy and Cell Biology





Ralph Nawrotzki in the "Skills Lab" at Heidelberg University

co-financed the acquisition of eight new ACUSON X700 ultrasound systems from the Commission's relatively meager student funds.

They decided in favor of the offer from Siemens Healthineers because they were looking for highly robust ultrasound systems that provided both intuitive operation and excellent image quality. "The new systems are, of course, fantastic – they make even the most intensive work straightforward. That allows us to make even more progress in the course, moving away from purely abdominal examinations and toward echocardiography," says Nawrotzki. And, in the months when the systems are not needed for the preclinical ultrasound courses, they are available in the training center – the so-called "Skills Lab" at Heidelberg University's Center for Internal Medicine – for use in clinical training. ●

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## Ralph Nawrotzki, MD, DPhil

has been group leader and educational coordinator of the preclinical studies section at Heidelberg University's Institute for Anatomy and Cell Biology since 2008 and is one of the initiators of the successful preclinical ultrasound course.

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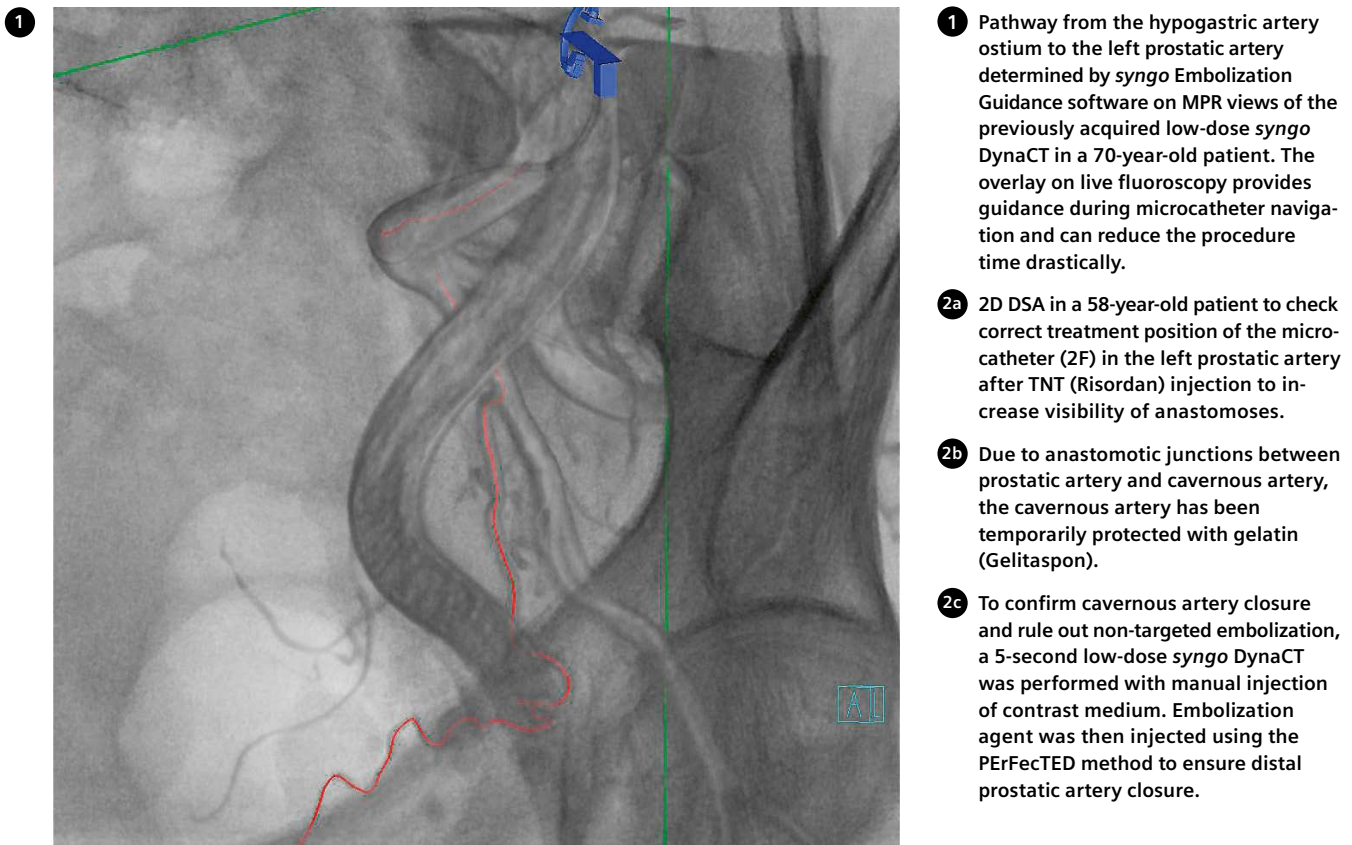
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# Prostatic Artery Embolization is Here to Stay

In 2018, prostate artery embolization (PAE) is probably on every interventional radiologist's radar. The minimally invasive procedure now has an established safety and efficacy record, and has made rapid gains in becoming accepted as an alternative to surgery for patients with troubling urinary tract symptoms due to prostate enlargement. This article features renowned experts from Brazil, Europe, and Australia who help give a global picture of PAE in practice and trace its development.

Text: Urmila Kerslake

Courtesy: Hôpital Européen Georges-Pompidou, Paris, France, and Southampton General Hospital, UK



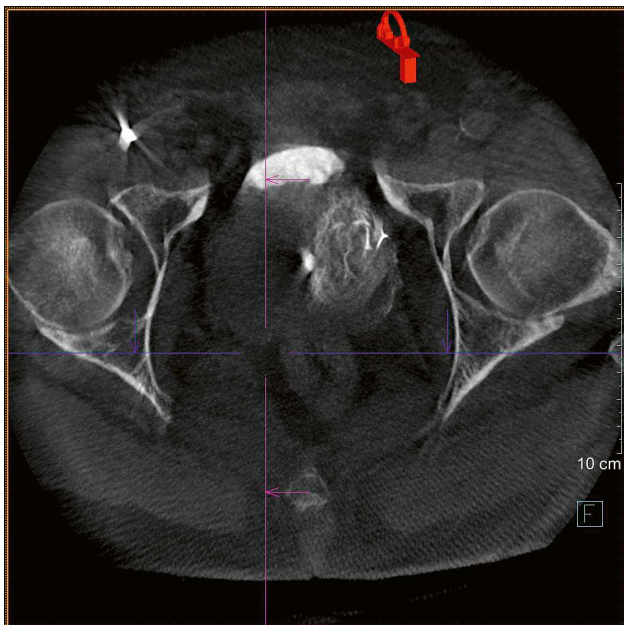
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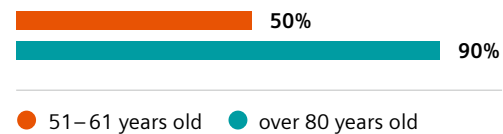
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**U**rology Health, the official foundation of the American Urological Association, estimates that 50% of men between the ages of 51 and 60 and up to 90% of men over the age of 80 can develop benign prostatic hyperplasia (BPH). The exact cause of BPH is unknown. This enlargement of the gland leads to lower urinary tract symptoms (LUTS), including urinary frequency, nocturia, difficulty urinating, and incomplete bladder emptying. These symptoms can lead to a significant impairment to quality of life. The main types of treatments available are active surveillance and lifestyle changes, medical therapy, and surgery. Many experts view "PAE" as a unique treatment, a "bridge" between medical therapy and surgery.

## Occurrence of BPH in older men

A man's chance of developing BPH increases with age

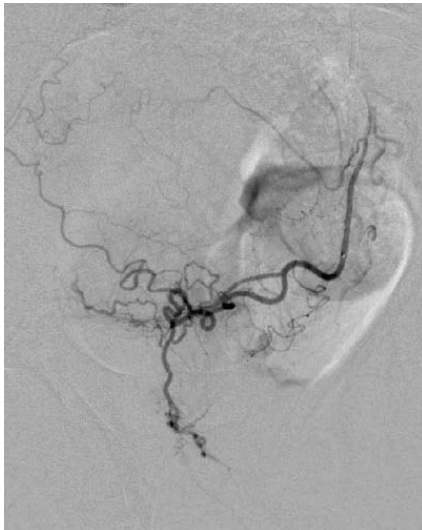


The available clinical evidence has shown that PAE (which involves catheter-based, superselective delivery of embolic material to the arteries to block the blood supplied to the prostate with the aim of shrinking it) is nearly as good as surgical alternatives such as transurethral resection of the prostate (TURP) at decreasing the size of the prostate, lessening troublesome urinary symptoms and improving patients' quality of life. Embolization scores over TURP in its safety profile and the length of stay in hospital for patients. One of the key reasons that men opt for PAE over surgery is that, unlike surgery, the minimally invasive procedure is associated with little or no retrograde ejaculation or sexual dysfunction after the procedure. Still, most interventional radiologists emphasize that PAE is a complex procedure that should only be offered to patients after multidisciplinary decision-making involving urology colleagues.

Francisco Cesar Carnevale, Associate Professor of Medicine, University of Sao Paulo, Brazil, is one of the pioneers of this new procedure and has worked strategically to gain widespread clinical acceptance of it. Since his first PAE cases in 2008, Carnevale has collaborated with urologists to put together the data needed to convince



3a



3b



3c



- 3** Images from a 70-year-old patient with lower urinary tract symptoms. (3a) DSA of left superior vesical branch. (3b) *syngo DynaCT* of left superior vesical branch shows minor anterior prostatic supply and penile collateral. (3c) *syngo DynaCT* shows the filling of a small wedge of the prostate. Since embolization from this position is not safe, the interventionist should reposition the catheter, reconfirm the therapy position, and only then embolize the prostatic branch.

the Brazilian Federal Council of Medicine (Conselho Federal de Medicina, CFM) in 2016 that PAE can be used as a new, alternative treatment for symptomatic patients with benign prostatic hyperplasia.

Carnevale explains: “PAE is being used all over the world as an attractive alternative to medical and surgical treatments for patients suffering from BPH because it is a minimally invasive procedure, performed under local anesthesia, usually on an outpatient basis, with few, or no reported cases of urinary incontinence, retrograde ejaculation, or erectile dysfunction. That is why embolization has gained a lot of support from patients and from medical specialists even outside interventional radiology.”

In April 2018, the UK’s National Institute for Health and Care Excellence (NICE), which provides national guidance and advice to improve health and social care, decided that the current evidence on the safety and efficacy of prostate artery embolization for benign prostatic hyperplasia is adequate to support the use of this procedure on the National Health Service (NHS). NICE’s decision took into account the UK ROPE registry’s findings that PAE was safe and that it provided a clinically and statistically significant improvement in symptoms and quality of life for men with enlarged prostate.

Nigel Hacking, a consultant interventional radiologist at Southampton General Hospital, Southampton, UK, is the clinical lead for the UK ROPE registry. He and co-authors of the study emphasize in the leading urology journal *BJU International* in April that “PAE is an advanced embolization technique demanding a high level of expertise, and should be performed by experienced interventional radiologists who have been trained and proctored appropriately. The use of cone beam computed tomography (CBCT) is encouraged to improve operator confidence and minimize non-target embolizations”.

## Efficient imaging modalities

Hacking states: “We perform our treatment planning on pre-interventional images. These are full high-resolution CT angiograms with maximum intensity projection (MIP) and 3D reconstructions to fully understand the anatomy of each internal iliac arterial tree with particular reference to the prostate arteries bilaterally and any important anastomoses. With regard to imaging modalities to assess the prostate anatomy, whilst ultrasound scans are typically used to assess prostate volume, CT angiography (CTA) is vital to accurately identify prostatic arterial anatomy. MRI is used if there is any concern about malignancy, but MR angiography has lower spatial resolution than CTA. From the CT angiogram



we draw out the arterial anatomy on each side on to a proforma arterial map which is referred to during the PAE procedure itself.

“The spatial resolution of CTA is sufficient for assessment of vascular anatomy and even for detailed planning of catheter navigation and determination of therapy position of the micro-catheter, as long as the technique is strictly adhered to.”

## Rigorous training needed for PAE

“Training and being appropriately proctored is mandatory before offering PAE due to the high-risk nature of the intervention. It should be a step-by-step process,” explains Marc R. Sapoval, Professor of Radiology, Hôpital Européen George-Pompidou, Paris, France, who performed his first PAE in 2013. He has trained more than 100 interventional radiologists in the procedure.

“When you ‘see’ the first case, you understand the overall intricacies of the technique, and the difficulties but also the rewards that you get from helping patients with this procedure. Onsite training at our institution involves physicians who want to offer PAE coming into the angiosuite to observe three cases. They are positioned near the table and observe the entire preparation, flow injection, discussion, and DynaCT runs (CBCT performed on the angiography system). At the end of the day, this is a great starting point.

“The next step is to have a proctor onsite. This is where an expert comes to the trainee’s institution. You can then schedule two to three cases in a day and the expert can guide you through these. You can also attend one- or two-day courses that are available from many vendors, and there are now simulator-based training packages for PAE,” Sapoval says.

## Vital to actively reduce radiation dose

“PAE is a complex procedure but radiation dose can be reduced for both the patient and operator,” reassures Goetz Richter of the Clinic for Diagnostic and Interventional Radiology, Katharinen-hospital Stuttgart, Germany. Richter’s team has succeeded in significantly lowering the dose for both uterine fibroid embolization and prostate artery embolization. Siemens Healthineers has a Combined Applications to Reduce Exposure (CARE) system functionality for all relevant modalities.

“Before embarking on dose reduction strategies, first and foremost, operators need to achieve adequate expertise in the pelvic vascular anatomy. Once this is achieved, it is important to set a low frame rate for fluoroscopy (4/s); low frame rate for digital subtraction angiography (DSA; 1/s or 0.5/s) and the best possible collimations. Additionally, it is critical to avoid DSA whenever possible by using fluoroscopy overlay technology and to use a minimum number of oblique projections. Whenever possible, it is also useful to employ image fusion guidance. All these measures will result in dose reductions for both the operator and the patient,” Richter explains.

## PAE in the angiosuite

Outlining the main requirements for performing PAE, Glen Schlaphoff, Director of Interventional Radiology, Liverpool Hospital, Sydney, Australia, identifies the first requirement as being a dedicated interventional unit that has access to nursing preoperatively, peri-operatively, and during recovery. “We then need an angiography machine, preferably an Artis zeego<sup>1</sup>, which allows total body coverage without moving the table. We have found this to be really important, having used a couple of different systems in the past. In my opinion, this robotic angiography system is highly suitable for PAE as it allows total body coverage from the radial artery to the groin, without having to move the table. This is crucial because there are very delicate catheter positions that can be altered if the patient moves. We also need access to a good workstation, rapid 3D assessment and rapid synchronisation of datasets, both CT and angiography, during the procedure. A DynaCT run must be efficient. And we need very good arm support in the radial position,” he says.

Rapidly accumulating evidence for PAE, its approval for routine use by national regulatory bodies, and an explosion in interest from interventional radiologists in training opportunities lead experts to believe that PAE is “here to stay”. ●

<sup>1</sup> The current product is ARTIS pheno.

**Urmila Kerslake** is a Bristol-based journalist. She is the Digital Education Lead and Senior Editor of the specialist quarterly newspaper, *Interventional News*, with which the content of this article first appeared as part of a supplement.

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# The Russian Oncology Pioneer

A Russian doctor has been pushing oncology diagnosis and treatment forward for nearly 15 years. Now he is opening the first center for proton therapy in the post-Soviet region. Meet Arkady Stolpner, MD, pioneer and co-founder of a medical network that serves millions.

Text: Moritz Gathmann | Photos: Fabian Weiss

**O**ther than a couple of new apartment blocks on the northern outskirts of St. Petersburg, nothing indicates that here, in the midst of a birch forest, a new chapter in Russian cancer treatment has just begun. In October 2017, the first center for proton therapy not only in Russia but in the whole post-Soviet region opened its doors. It is an example of innovative entrepreneurship and a sustainable, trustful relationship between a customer and its suppliers of medical equipment.

Arkady Stolpner, MD, a man in his fifties and still full of energy, opens the doors of the newly built clinic and leads us straight to its core: A nearly three-floor high apparatus, a ProBeam Superconducting Cyclotron, that allows dose delivery to deep-seated tumors. The machine can be rotated 360°, delivering the beam at any desired angle – with the patient never seeing anything of the huge machine as he or she lies in a treatment room that is reminiscent of the interior of a spaceship in a Star Trek movie.

## A cooperation that goes further

What Stolpner has accomplished here, with a private investment of 130 million USD, is the high point of 14 years of engagement in oncology diagnosis and treatment. Back in 2003,

Stolpner and his partner, the late Sergey Berezin, MD, founded the first privately owned magnetic resonance imaging center in Russia, the Dr. Berezin Medical Institute (MIBS). Over the years, MIBS has opened more than 90 diagnostics centers all over the country – providing one fifth of all diagnoses with MRI in Russia – as well as centers in neighboring Armenia and Ukraine.

## An example of public-private partnerships

An important factor in Stolpner's success is his partnership with the state. For his latest project, the city of St. Petersburg provided the property under attractive conditions and took care of the communication lines and a link road. But even more important in a country like Russia, where the medical sector is still dominated by the state, are quotas for diagnosis and treatment. In the first year, of the 800 patients that can be treated at the facility, the city of St. Petersburg will pay for at least 100 people – with at least 50 of these being children. So far, all the other treatments will be privately paid. "In order to have a projectable future, we need more long-term agreements," says Stolpner. He hopes that a certain law will be amended in the near future, making it possible to include institutions like the proton therapy center in state programs.

Arkady Stolpner,  
MD, founder of the  
first center for pro-  
ton therapy in the  
post-Soviet region.







Modern both in terms of technology and interior design: Arkady Stolpner's center for proton therapy on the outskirts of St. Petersburg.

The Russian state certainly appreciates innovative entrepreneurs like Stolpner. Veronika Skvortsova, the country's Minister of Health, commenting on the opening of the proton center in St. Petersburg, praised it as an example of public-private partnerships. "This is the future and the present of Russian medicine," said Skvortsova.

Although the situation is improving, in Russia the overall risk of dying from cancer is about 60%, compared to 40% in the United Kingdom

and 33% in the United States.[1] The main problem is that people living outside of major cities have inadequate access to cancer care facilities, notes Paul E. Goss, MB BCh, PhD, professor of medicine at Harvard Medical School and director of breast cancer research at the Massachusetts General Cancer Center in Boston, in a report on Russia, China, and India in *Lancet Oncology* in 2014.[2] The availability of radiation therapy in particular has declined since the collapse of the Soviet Union.

## Strategies in the face of tough competition

In any case, the field of medicine in Russia has become much more competitive compared with 2003, when Stolpner and his partner started out. What is their business strategy amidst a competition that attracts clients with lower fees? "Service, reliability, competence, and efficiency," is Stolpner's answer. His new treatment center is a prime example: Rooms flooded with light, a comfortable indoor climate, and special features for its very young patients, such as a small zoo with two monkeys named Quentin and Uma. A full-scale examination that might take two weeks as an inpatient in state-owned clinics can be performed at the MIBS facilities in two days – as an outpatient. And the wide range of possible methods offers a varied treatment approach – and thus better chances of healing.

The basis of this clinical network is a strategic partnership with Siemens Healthineers. "We go together well," Stolpner puts it. While Varian is the backbone of the network of centers in the field of radiation therapy, Siemens Healthineers provides all the MRI and CT technology through ecoline systems – also at his new hospital. "What is most important for us are the low downtime rates of Siemens' equipment," says Stolpner.

But the cooperation doesn't end with the purchase of equipment. Siemens Healthineers supports Stolpner's efforts to develop medical expertise in the region, for example through its annual School of Clinical Radiology, at which Stolpner gathers some of Russia's best oncology experts at his facilities. He is proud to report that a team of these doctors recently published an article in the renowned *British Medical Journal* on "CT and PET/CT fusion for lung cancer biopsy planning". Siemens Healthineers, in turn, profits from the expertise that Stolpner's employees gain while working with their equipment – and then share with the company.



Dose delivery to deep-seated tumors with the ProBeam Superconducting Cyclotron (above). From the control room (below) the machine can be rotated 360°.

*"This is the future and the present of Russian medicine."*

Veronika Skvortsova, Russian Minister of Health



Stolpner was a pioneer when he opened the first privately owned MRT center in Russia – because 15 years ago there was a huge lack in the field of diagnosis. Nowadays, the waiting time for an MRT diagnosis in most parts of Russia is less than in France, according to Stolpner. That's why he turned to treatment: In 2008, his clinic in St. Petersburg was the second one in Russia equipped with a Gamma Knife. In 2011, Stolpner added a Cyber Knife to his portfolio. With the completion of the proton therapy center, MIBS is now state of the art in the whole post-Soviet region.

But Stolpner does not intend to rest on his laurels: He has recognized that a big problem in oncological treatment in Russia is the lack of consultation with other doctors. "Your particular doctor may be a surgeon, a specialist in radiotherapy or chemotherapy. And he or she will treat you according to this narrow expertise," explains Stolpner. That's why, while building his

new hospital, Stolpner made sure to include a room for consultation with a special bench for the doctors and a big screen on the wall. "That's where the doctors with different expertise will discuss a patient – and decide which combination of treatment will promise the best chances for healing." ●

**Moritz Gathmann** has been working as a correspondent in Russia and other post-Soviet countries for a variety of German magazines and newspapers since 2006.

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[1] <https://www.medscape.com/viewarticle/824151>

[2] [http://www.thelancet.com/journals/lanonc/article/PIIS1470-2045\(14\)70029-4/fulltext](http://www.thelancet.com/journals/lanonc/article/PIIS1470-2045(14)70029-4/fulltext)

# Tomosynthesis and Contrast-Enhanced Mammography Improve Cancer Detection

Although tomosynthesis – or 3D mammography – has only recently emerged as a promising tool in breast cancer detection, image acquisition and interpretation strategies are now being optimized through technological and reading workflow improvements. Coupled with contrast enhancement, mammographic techniques now even enable functional imaging of cancer tissue.

Text: Martin Lindner

**E**xperts at the European Congress of Radiology explained that new mammographic methods could take breast cancer detection to a new level. More specifically, optimized tomosynthesis protocols and contrast-enhanced images offer promising possibilities.

## **A new standard in breast cancer detection**

In recent years, a range of advancements in digital mammography have helped to greatly improve breast cancer detection. Indeed, in many countries, these developments are changing the way radiologists work. Key to this is an improved morphological and functional assessment of breast tissue.

In particular, tomosynthesis, also known as 3D mammography, offers the potential for significant clinical improvement. "The superiority of digital breast tomosynthesis compared to digital mammography for cancer detection in screening is





Presentation of new mammographic methods at the European Congress of Radiology

undisputed,” says radiologist Sophia Zackrisson of Lund University, Sweden, who directs an extensive cohort study that compares one-view tomosynthesis with two-view digital mammography for screening purposes.[1] According to the study’s final results, which are now being prepared for publication, over 30% more cases of breast cancer were able to be detected using the 3D reconstruction method than with conventional two-view digital mammography – a development that coincides with other investigations, reported Zackrisson.

Many experts see tomosynthesis as a new diagnostic standard – one that could become established in the future for population-wide screening programs. However, to reach that level, reading times, which are currently up to twice as long with tomosynthesis as with conventional mammography, will have to be shortened. Here, the crux of the problem is the sheer quantity of image material. One strategy for overcoming this is to combine several of the reconstructed cross

sections into thicker image layers (“slabbing”), says Zackrisson. Another promising possibility might be computer-assisted reading approaches in which, for example, intelligent algorithms sort out normal scans beforehand, thus easing the workload of the radiologist. “CAD and AI are definitely a way forward,” said Zackrisson.

### Optimizing image acquisition and reconstruction strategies

It should be noted that the technical parameters of image acquisition already play a role in the efficiency of tomosynthesis. During a procedure, an X-ray tube goes around the breast in order to obtain image projections from different perspectives for 3D reconstruction. According to radiologist Paul Fisher and medical physicist Wei Zhao, both from Stony Brook University, New York, if an X-ray source has a larger angular range, image quality appears to be higher than in the case of a smaller angular range. This is explained by the fact that, in the case of a wider



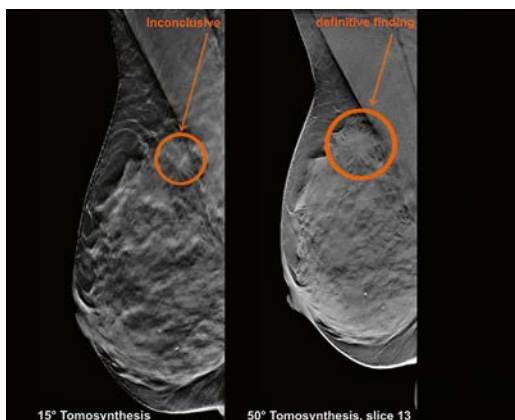
Attendees of the European Conference of Radiology in Vienna, Austria

angle, the inside of the breast can be viewed more easily and thus fewer data artifacts are necessary for image reconstruction.

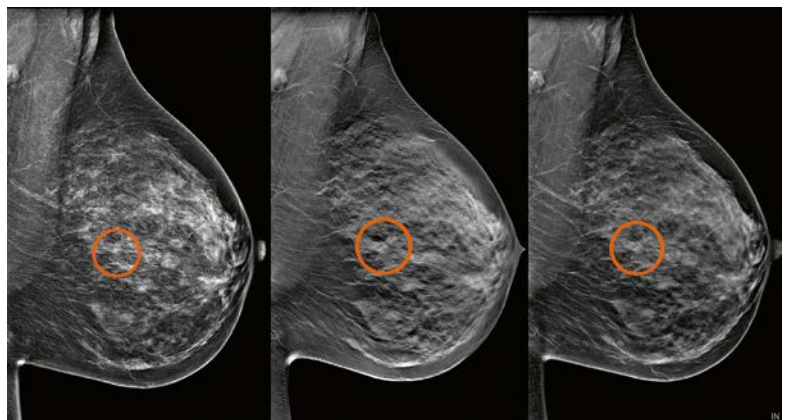
Based on model simulations, Fisher and Zhao's team conducted a clinical pilot study in which radiologists compared images from two different tomosynthesis systems with angular ranges of 15 and 50 degrees, respectively. The result: In very dense areas of the breast especially, in which foci of cancer often remain masked by surrounding tissue, suspicious masses can be better detected by a wide-angle system, according to Fisher and Zhao. Whether cancer detection can also be optimized in everyday clinical

practice as a result remains to be proven by larger studies. However, an earlier investigation using phantoms demonstrated that image reconstructions by wide-angle systems have less signal noise and tend to be preferred by radiologists.[2]

Also important for the reading process is easy orientation in the tomosynthetic image material. Currently, conventional full-field digital mammography (FFDM) is therefore often performed in addition to tomosynthesis, to expedite image interpretation and facilitate comparisons with prior images, using the overview image in 2D.



Invasive lobular carcinoma grade 2: At 15° Tomo, the finding is inconclusive, while the 50° Tomo shows the finding definitively. Courtesy of Wayne Lemish, MD, MIA Radiology, East Melbourne, Australia



ILC 1.8 cm with DCIS G2 10 cm: FFDM, DBT, and synthetic mammogramm. Courtesy of Prof. Th. Helbich, MD, Maria Bernathova, MD, Paula Clauser, MD, University Hospital Vienna, Austria



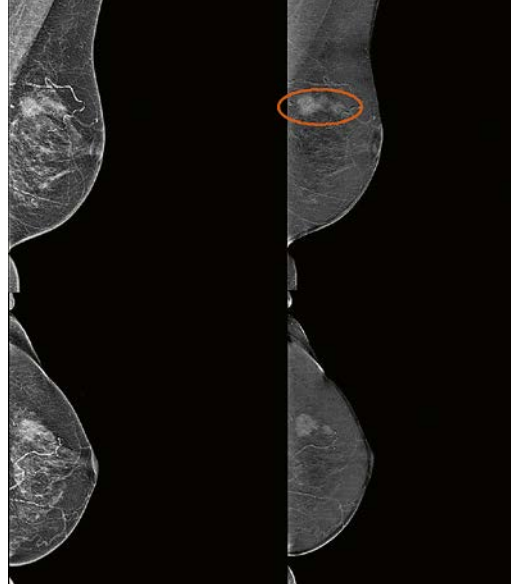
A current alternative to FFDM is a “synthetic” mammogram reconstructed from tomosynthesis data, explains Paola Clauser from the Medical University of Vienna, Austria. “Synthetic mammography provides a reliable 2D image – without the need for double radiation exposure,” said Clauser. Other studies have supported the diagnostic value of this approach. Conventional mammography remains superior to synthetic images in its own right, yet in combination with tomosynthesis, they represent a trendsetting approach.

## Toward functional diagnostics in mammography

Yet another new paradigm is emerging: The use of mammography for functional imaging. This is based on the fact that, in order to grow, breast tumors form new blood vessels.[3] This neoangiogenesis can be made visible at a high resolution if a contrast agent containing iodine is given during the examination, explains Luis Pina from Clínica Universidad de Navarra, Spain. The method, known as contrast-enhanced dual energy mammography, works with X-rays of different energy levels that are attenuated to different extents by breast tissue and the iodine contrast agent. In addition to a low-energy mammographic image, which can be compared to a conventional mammogram, a high-energy image is acquired leading to a calculated subtraction image, which sets apart and unmasks heavily perfused tumor tissue from its surrounding area.[4]

“The approach is a problem-solving technique,” stresses Pina. In cases that cannot be sufficiently clarified through mammography or tomosynthesis, the contrast agent method often provides further help, for example, in the case of particularly dense breast tissue, preoperative staging, or follow-up of scars. In many constellations, the method offers an alternative to magnetic resonance imaging, which – if applicable – takes longer and can be quite costly.

In addition, contrast enhancement is also possible in tomosynthesis<sup>1</sup>, as Fisher adds. According to initial study results with a prototype system, contrast-enhanced tomosynthesis enabled a particularly good assessment of the diagnostically important margin areas of lesions suspected of being cancerous. Moreover, it was possible to generate synthetic 2D overview images as is the case with examinations without a contrast agent.



71-year-old female with a palpable lump (left breast): The mammogram shows an irregular mass, margins are not clearly seen; the size of the cancer is difficult to assess. TiCEM shows the real size of this 30 mm invasive lobular carcinoma. Courtesy of Prof. Luis Pina, MD, University of Navarra, Pamplona, Spain

The latest diagnostic systems, such as MAMMOMAT Revelation, actually integrate all of these methods and can be used for traditional as well as contrast-enhanced mammographies, tomosynthesis, synthetic image reconstructions, and image-guided biopsies. These advanced devices allow radiologists to choose the best approach in each case from a growing repertoire of methods, depending on the clinical constellation. ●

### Martin Lindner

is an award-winning science writer based in Berlin, Germany. After completing his medical studies and a doctoral thesis in the history of medicine, he went into journalism. His articles have appeared in many major German and Swiss newspapers and magazines.

### References

- [1] Lång K, Andersson I, Rosso A, et al (2016) Performance of one-view breast tomosynthesis as a stand-alone breast cancer screening modality: results from the Malmö Breast Tomosynthesis Screening Trial, a population-based study. *Eur Radiol* 26:184-90
- [2] Goodsitt MM, Chan HP, Schmitz A, et al. (2014) Digital breast tomosynthesis: studies of the effects of acquisition geometry on contrast-to-noise ratio and observer preference of low-contrast objects in breast phantom images. *Phys Med Biol* 59:5883-902
- [3] Schneider BP, Miller KD (2005) Angiogenesis of breast cancer. *J Clin Oncol* 23:1782-90
- [4] Kariyappa KD, Gnanaprakasam F, Anand S, et al. (2016) Contrast enhanced dual energy spectral mammogram, an emerging addendum in breast imaging. *Br J Radiol* 89:20150609

### <sup>1</sup> Prototype

This product is under development and not commercially available. Its future availability cannot be ensured.

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Results from case studies are not predictive of results in other cases. Results in other cases may vary.



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# Multidisciplinary Usage: The Future of Intervention

At Istanbul's Liv Hospital, the cardiology and interventional neuroradiology departments share an angiography system in order to work more efficiently – a trend that is becoming increasingly popular at private hospitals.

Text: Jürgen Gottschlich | Photos: Nicole Tung



Professors Alp Burak Çatakoglu, Head of Cardiology, and Adem Uçar, Head of Radiology at Liv Hospital in Istanbul.



**T**he attractive villa would be almost indistinguishable from the neighboring gated communities of the Ulus district were it not for a sign at the entrance directing people to the emergency department. On a small table next to the reception stands a collection of flags representing the countries whose languages are spoken here – and there are lots of them. One in four patients is from abroad, and a 15-people-strong team of interpreters is on hand to ensure effective communication. Decorated in muted browns and beiges, the corridors spread out through the building like blood vessels. The physicians speak softly, the atmosphere feels focused, and the staff is eager to help.

With 30,000 square meters of floor space, this exclusive new hospital provides 154 beds and eight top-notch operating rooms. In just the past year, almost ten thousand procedures were performed here. As well as complex cases, Liv also welcomes affluent patients with special requirements, particularly in the areas of cardiology and stem cell therapy.

### Renaissance of a medical tradition

“Private hospitals are experiencing a boom in Turkey,” says Yüksel Yazıcı, Head of the Biomedical Branch of the Medical Park Group, the holding company behind the Liv Hospital chain. Having trained as a biomedical and electronics engineer, Yazıcı has a broad scope of responsibility: The Medical Park Group was founded in 1993 and maintains 29 facilities nationwide under the names Medical Park, Liv Hospital, and VM Medical Park. Founded three years ago, the group’s private Istinye University is tasked with training the next generation of physicians in parallel to the teaching they receive from the hospital’s medical team. “You can also view it as the renaissance of an age-old tradition,” Yazıcı explains.

### Multidisciplinary usage improves workflow and utilization

“Until two years ago, we worked with a monoplane system,” explains Professor Alp Burak Çatakoglu, Head of Cardiology at Liv Hospital.

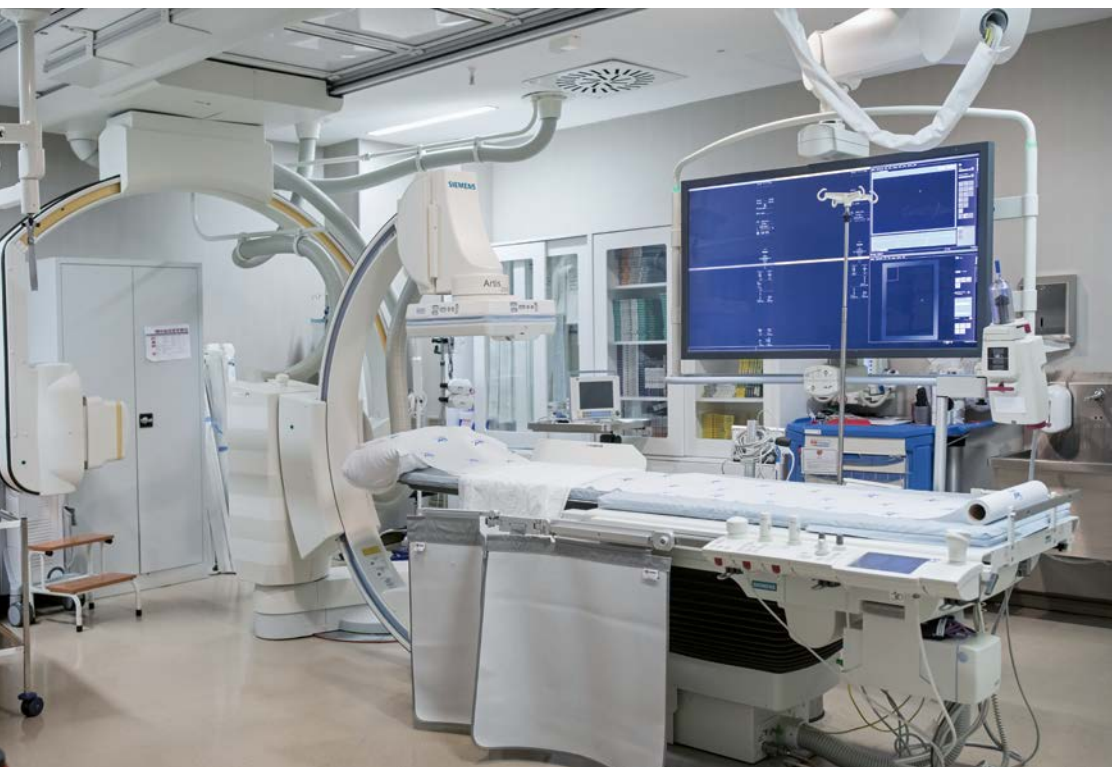


At Liv Hospital, the interior design is as contemporary as the technology is state-of-the-art.

“Since we began sharing one system, we’ve benefited from each other’s expertise. I’ve learned a lot about cardiological contexts, although I primarily use the system in interventional neuroradiology.”

Professor Adem Uçar, Director of Radiology

However, this equipment was not operating at sufficient capacity. The hospital’s search for a solution led it to an angiography system that is suitable for both cardiology and interventional radiology. “After we received the Artis zee biplane angiography system, my work became considerably easier. It’s a state-of-the-art system that, among other things, also offers dedicated functions for cardiology. I’m particularly pleased with the razor-sharp quality of the 3D images, and we also use less contrast agent.” With the



The Artis zee biplane system is used by physicians from different departments, resulting in a broader exchange of knowledge.

system's interdisciplinary applications and greatly expanded technical capabilities, much more demanding interventions can be performed in a more thorough way than with the previous monoplane system. "With a DynaCT run, I obtain almost tomographic quality," explains Çatakoglu.

The hospital's team of four cardiologists includes two who are responsible for interventions, one for arrhythmia problems, and one for noninvasive examinations. The department performs around a thousand cardiac interventions each year, the majority of which are complex cases.

Patients are admitted after failed operations or to receive treatment for chronic conditions such as cardiac dysrhythmia.

"Normally, patients come to us based on a recommendation," explains Çatakoglu, who also sits on the board of the Turkish Society of Cardiology. "One benefit is that our angiography system is also suitable for precise measurements relating to the condition of the epicardial vessels, like FFR – fractional flow reserve." At Liv Hospital, wireless FFR was made possible for the first time in Turkey thanks to a collaboration between Siemens Healthineers and Abbott.

## Advantages of multidisciplinary collaboration

The angiography system is housed in a relatively small room and is used by physicians from different departments, such as cardiology and interventional neuroradiology, according to a precise weekly schedule. Large screens allow the patient to follow the imaging process themselves, and the physicians are only too happy to explain it to them.

Professor Adem Uçar, Director of Radiology, highlights the successful collaboration with his colleagues: "Since we began sharing one system, we've benefited from each other's expertise. I've learned a lot about cardiological contexts, although I primarily use the system in interventional neuroradiology. Both the time I save thanks to the biplane system and the low amounts of contrast agent required are particularly beneficial in pediatrics and in patients with kidney problems."

Like Professor Çatakoglu, he also believes that multidisciplinary represents the future of intervention: "The multidisciplinary system broadens the range of treatments we can provide, allowing hospital management to plan the patients' pathway more comprehensively and in greater detail."

## Quick, local service

"The key factors in our decision to buy Artis zee were the cost savings due to multidisciplinary use, the quick, local service, and the excellent technical support that goes with it," says Head of Purchasing Yüksel Yazıcı. "The procurement costs, operational expenses, high standards, and optimum utilization by our physicians are also significant factors." One key point, he says, is that Siemens Healthineers has an excellent infrastructure in Turkey: "The setup process needs to be fast, as does any repair work." Looking forward ten years, it is important that systems can be upgraded.

Although Turkey has potential for growth in terms of medical technology, private hospitals in particular are very well equipped. For the physicians, this represents not only a challenge but also a source of satisfaction. In the future, Professor Çatakoglu would like to see a system that can be integrated into the existing infrastructure, and that delivers accurate reports in a shorter time. "One day, we'll be able to perform operations from home." ●

*"The multidisciplinary system broadens the range of treatments we can provide, allowing hospital management to plan the patients' pathway more comprehensively and in greater detail."*

Professor Adem Uçar, Director of Radiology

**Jürgen Gottschlich** has worked as a correspondent for German-language media in Istanbul for over 15 years. He is a trained journalist and the author of several books about Turkey.

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With the Artis zee biplane system, the Liv Hospital team has found an angiography system that is suitable for both cardiology and interventional radiology.



# Improving the Big Picture: CT Flowmaster Transcends Departmental Boundaries

The CT Innovation Unit at Herlev Hospital in Denmark has organized, tested, and implemented a more efficient way of using their available CT scanners for acute patients by creating the position of “Flowmaster”. The result is improved patient safety, more cost-efficient care, less waiting time for physicians after having ordered a CT scan, and staff who are better able to focus on their main tasks instead of administrative work.

Text: Nils Lindstrand | Photos: Jan Sondergaard



**Fast and mobile:**  
The Flowmaster  
is in contact with  
doctors and staff  
beyond the radiol-  
ogy department.



**H**erlev Hospital is a skyscraper, actually the tallest building in Denmark, rising 120 meters over the town of Herlev on the northern outskirts of Copenhagen. But Herlev Hospital excels in other ways as well. To ensure the best possible use of the radiology department, the Capital Region of Denmark and Siemens Healthineers joined forces in 2013 to create the first Danish CT Innovation Unit. The Unit comprises representatives from all different teams, radiographers, doctors, and managers.

“We are the only Innovation Unit at departmental level at Herlev Hospital,” says project manager Henriette Raaschou. “But serving all



other departments, be they cardiology, neurology, or trauma units, our work has the potential to impact the entire hospital. You could argue that the staff members at the department of radiology are the last generalists in healthcare, involved in the care of all kinds of patients.”

### Optimizing workflow

The radiology department at Herlev Hospital has seven CT scanners, with one traditionally being used for acute patients. By scanning 65 acute patients on a normal day, the patient volume is high at the Danish hospital. And sometimes, even one dedicated acute scanner is not

enough. Keeping in mind that the quicker acute patients are scanned and diagnosed, the quicker they can get the correct care, it is crucial to establish an efficient CT workflow – from ordering a CT to the scanning itself and from managing patient load in a smart way to keeping patient safety high, while at the same time utilizing all available scanners optimally. This can be particularly challenging, because all the department’s other scanners are mostly fully booked, especially during peak hours. So the CT Innovation Unit identified the need for an overall workflow improvement regarding the CT management, with special attention placed on relieving staff and using their competencies optimally. To be more

**On the go:** The Flow-master, a position held by a member of the radiological team, ensures an efficient workflow.





The Flowmaster's main task is keeping an overview of the workflow.

concrete, the goal for the radiographers was to be able to focus on the scanning process and for the radiologists to be able to concentrate on the analysis, ideally with someone else taking

care of the workflow optimization. The result of this discussion was the creation of the Flowmaster position.

"It's a bit like the work of an air traffic controller," says Felix Müller, MD, one of the doctors in the CT Innovation Unit. "One person takes on the single task of having an overview of the flow, making sure that the staff and equipment are working efficiently. When this works, the scanners are all used optimally at any given time, and no staff or equipment is ever idle."

## Measurements with and without a CT Flowmaster at Herlev Hospital

Time from referral to scanning



Patients scanned within 120 min. after referral



Patients scanned within 240 min. after referral



Percent of examinations during daytime (8 am – 3 pm)



● With Flowmaster ● Without Flowmaster

## Significantly shorter scanning procedure

This new system was first tested in November and December of 2017. Over a period of six weeks, the scanning department alternately worked with and without a Flowmaster, first every other week, then two weeks at a time. The result was very positive: "We were able to scan more patients during 'daytime' – that is, before 3 pm," says Müller, "and the average time from ordering a CT scan until the time the patient is scanned was reduced by more than 20 percent."

The majority of patients in the highest priority group are scanned within one hour, and, in the second priority group, where patients are to be scanned within two hours, almost every patient was scanned in time. "We are very happy to be able to guarantee this," the doctor says.

## Higher equipment utilization and efficiency

The goal of using the equipment more efficiently also seems to have been reached. "There is far less dead time when a Flowmaster is working", says Henriette Raaschou. "He or she manages to steer patients to an available scanner very efficiently."

Improved safety for patients and more efficient use of all resources are thus two goals achieved by the Flowmaster approach. The third goal, more room for the staff to focus on their main tasks, seems to have been achieved as well: "Especially during peak hours, the advantage of having a Flowmaster in contact with the doctors and other staff beyond the radiology department is great," says radiographer Ulrik Frost. "This means we can focus on the scanning process without being distracted, by patients arriving late, for example."

## Bottom-up approach

The Flowmaster project was accomplished within an unusually short time period. One reason for this was that the necessity to improve organization was identified within the department itself, by the CT Innovation Unit at the radiology department and by the people scanning patients every day. This bottom-up approach was the reason why all staff members involved were highly committed.

During the weeks when the two systems, with and without a Flowmaster, were alternating, the staff were interviewed at the end of each workday to map how the difference was perceived. By engaging the staff in this way, the project was, in many ways, being implemented at the same time as it was being tested and evaluated.

It was with the same efficiency that the management decided, in March of 2018, to make the Flowmaster a permanent position within the radiology department, meaning that one member of staff would always have the specific task of maintaining an overview.

## Innovation is key

"The management has been very dedicated to this project and to the creation of the Innovation Unit," says Henriette Raaschou. She has been working at Herlev Hospital as a radiographer and has now been given the opportunity to do



The Flowmaster manages patient flow and makes sure that the scanners are utilized optimally.

*"One person takes on the single task of having an overview of the flow, making sure that the staff and equipment are working efficiently."*

Felix Müller, MD, CT Innovation Unit

a Master's degree in leadership and innovation in complex systems, to give her and the hospital better tools to continue working with innovation.

"I think it's important for innovation in medical care to focus on the workflow, on the big picture, and not on individual systems or persons," she says. "This means that we need to give innovation much more attention than we do currently. The use of innovative approaches can create additional value, which in turn has the potential to affect the whole hospital." ●

**Nils Lindstrand** has been working as a science writer and journalist for more than 30 years. He is based in Stockholm.

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Dr. Iain Duncan, Nick Ingold, and Dr. Chandi Perera gather around Garran Medical Imaging's Symbia Intevo SPECT/CT to discuss a recently imaged patient.

## Revealing More Diagnostic Information with SPECT/CT

Demands for more patient-centered care are reshaping the role of imaging. Technologies that differentiate good images from great ones – those that boost the level of clinically relevant information and offer clarity on a patient's condition – are finding their place.

Text: Clement Webster | Photos: Geoff Comfort

**F**or nuclear medicine, xSPECT Bone™ aims to accomplish high-level differentiation by taking a new approach in the generation of SPECT/CT images. Iain Duncan, MD, co-founder of Garran Medical Imaging (GMI) in Canberra, Australia, explains that the technology, “seems to side-step a limitation of SPECT/CT – the lower spatial resolu-

tion of the SPECT component of the fused imaging. With xSPECT Bone, the gamma information is re-engineered to use the detailed spatial information about the tissues from the CT scan. It's just a better image from the start.”

When introduced in 2013, the technology immediately caught Duncan's attention. Convinced it would have

a major clinical impact, and provide great value to referring physicians, he and his team decided to install xSPECT Bone in their brand-new practice in Canberra, the Australian Federal capital. That was July 2015. Since then, Duncan has become one of the most active xSPECT Bone users in the world and a tremendous advocate of the technology in Australia.

## A patient-centric approach

"With xSPECT Bone imaging, our reports consistently have a high level of information upon which we can act," shares Duncan. "This helps us better communicate with our referrers so they, in turn, can better manage their patients."

The ability to use this additional information is crucial. Duncan emphasizes that "understanding individual patients is vital. One of the biggest pieces of advice I would give anyone is that you must be much more aware of the patient's background in relation to the scans. xSPECT Bone scans provide you with a lot more information."

Applying it in relation to a patient's history and symptoms is key, and it allows you to be very patient specific in your findings. All of our patients now fill in a detailed questionnaire about their symptoms and their pain, and they draw where their pain is on maps of the body," he says.

Recognizing how this technology could potentially advance their practice's efforts to provide patient-centric care, Duncan and his team realized that, as with any change, they had to take proactive steps to understand the differences and benefits of their new technology. They also recognized the need to work closely with their referring physicians to help them leverage the additional information and insights that xSPECT Bone offers over traditional SPECT/CT.

## The clinical value

With xSPECT Bone, Duncan admits he had to adapt his usual approach to analysis and diagnosis. "It's a different way of looking at scans, so your brain has to adjust. Naturally, this takes a bit of time."

To fully understand the clinical utility of xSPECT/CT Bone compared with standard SPECT/CT reconstruction, Duncan and team decided to prospectively evaluate their first 200 cases.

"In August 2015, we set up a study where we performed sequential reporting of SPECT/CT followed by xSPECT/CT. Differences between the initial SPECT/CT and the final report (after xSPECT/CT Bone reconstruction) were documented and analyzed."

"Our findings, published in the *European Journal of Hybrid Imaging*, showed that xSPECT Bone imaging makes a big difference; it provided us with more diagnostic information in 71% of scans," Duncan emphasizes. At the end of the study, they concluded that xSPECT/CT Bone reconstruction offers notable imaging improvements over standard SPECT/CT reconstruction algorithms. "When using xSPECT Bone, we changed our diagnosis in 20% of the cases. Since the imaging improvements are often clinically significant, they have the potential to improve diagnostic accuracy," Duncan states.

The GMI team now performs all of their bone scans with xSPECT Bone, but

Garran Medical Imaging, in Canberra, Australia, installed xSPECT Bone imaging in July 2015.



## 5 considerations when implementing xSPECT Bone

The Garran Medical Imaging team's top five suggestions on how to implement xSPECT Bone:



1. Educate yourself on image differences between xSPECT Bone and traditional SPECT/CT (consider doing side-by-side viewing for the first few exams).



2. Create the necessary workflows as soon as the software is installed.



3. Make sure communication with referring doctors is open and detailed.



4. Spend time educating referrers about the technology and the differences between xSPECT Bone and traditional SPECT/CT scans. Make sure they understand precisely how big those differences are and the benefits they offer.



5. Confer with referring physicians on the background of their patients. Have patients provide detailed information about their pain and medical history.

*"The days of 'unclear medicine' are over now that xSPECT Bone is here."*

Nick Ingold, B.MRS(NM), Garran Medical Imaging

according to Duncan, the technology has the most impact when imaging smaller lesions. "The most frequent changes in diagnosis we encounter are related to sacroiliitis – which we diagnosed with xSPECT Bone imaging but not on prior bone scans – focal inflammation in thoracic spine small joints, focal osteochondral injuries/degeneration, and subtle bone stress lesions in athletes' ribs and feet," Duncan reveals. The technology's impact is noticeable, "in defining uptake as articular rather than periarticular and in defining subtle bone stress lesions in ribs and lower legs," he adds. And, with the Australian Institute of Sport (AIS) and its elite athletes close by, Duncan and team find that xSPECT

Bone allows them to more appropriately serve their orthopedic and sports medicine communities.

### Implementing xSPECT Bone

To guarantee GMI was able to leverage the technology's capabilities, GMI's practice manager and chief technician, Nick Ingold, had to ensure the successful integration of the technology. "I had to confirm the workflows we use were set up correctly with the xSPECT Bone acquisition and reconstruction parameters. These are somewhat different from standard SPECT parameters and need to be correct for xSPECT Bone reconstruction to properly run. Because the image quality is

so much better and quite different from traditional SPECT/CT, I also aligned with my nuclear physician to determine the best method of image display and his requirements for images being sent to the PACS," he states. Ingold found that when he fused xSPECT Bone datasets with CT datasets, the true benefit of the additional detail and resolution was even more evident.

Overall, the integration of the technology was quick and made no significant change to daily workflow, Ingold stresses. "The system processing/reconstruction of the xSPECT Bone image takes slightly more time than traditional SPECT reconstruction, but this addi-



## A referring physician's perspective

According to Chandi Perera, MD, director of the rheumatology unit at Canberra Hospital, the advent of xSPECT Bone was a significant development in medicine. "xSPECT Bone is a powerful, advanced anatomical and functional diagnostic tool," he states. "The fidelity of the images is much higher than we have had before, which gives us the detail we require for decision-making."

When asked what this means for patients, Perera shares, "good images are helpful, but often don't reveal the level of information needed, which can potentially delay diagnosis. With xSPECT Bone, the images are great. Connecting the detailed images with patient history and symptoms lends itself to more patient-specific assessments. In the end, it's the patients who benefit."

The transition to interpreting xSPECT Bone imaging at Canberra Hospital was smooth, he states. "Iain came to the hospital and talked about xSPECT Bone, so we were aware of what it could do. Another advantage is that GMI is very close, so we can easily discuss the images."

"When striving to deliver more patient-centered care, the clear reports help provide insight into a patient's situation. They are also valuable when conferring with patients about their condition and the best course of care. xSPECT Bone is a communication tool as well as a diagnostic one," Perera concludes.

tional time does not pose any detriment or change to my daily workflow.

"After using xSPECT Bone, we also discovered that high image quality is not in question, even with a short acquisition time and/or lower patient dose. Decreasing the time per view of the SPECT acquisition or decreasing the dose administered to the patient does not degrade our image quality when we reconstruct with xSPECT Bone."

### Spreading the word

The addition of xSPECT Bone imaging was a leap forward. "To spread the word about our new technology, we held information sessions for our referrers and hosted two general practitioner education events that included orthopedic and sports medicine clinical input," Duncan reveals. "I also gave specific lectures to rheumatology and oncology groups at Canberra Hospital and to the physicians at AIS. Additionally, we put

information about xSPECT Bone on our website, and I include direct links to this information in my reports."

"We find our referring physicians are quite satisfied with the precise reports and appreciate the open lines of communication," shares Duncan. "A lot of them are reaching out to us now because they have come to understand that xSPECT Bone is something different," Ingold adds.

When recounting GMI's experience with xSPECT Bone, Duncan further explains that the clinical effect of this technology is a positive and significant one. "The detail in xSPECT Bone, particularly for musculoskeletal problems, has allowed us to make bone scan interpretation specific to each patient in a way never before possible. By providing a more complete picture of a patient's situation, we can help facilitate better communication and more effective decision-making."

According to Ingold, "the additional information and resolution we visualize with xSPECT Bone is amazing. Subtle or no pathology on planar images is now clearly visible. These changes are real and may not have been recognized without xSPECT Bone. The days of 'unclear medicine' are over, now that xSPECT Bone is here." ●

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Cooperation is very much the key to success for the new emergency department: Christian Christiansen, MD, Lene Guldberg Hansen, MD, and radiographer Martin Weber Kusk (from left to right) at Sydvestjysk Sygehus hospital discuss a case.

# Cooperation and Technology – the Keys to a Danish Hospital's Success

A Danish hospital invested in the latest technology for its emergency department. This led to a complete reorganization – and a journey to the top of the country's hospital ratings.

Text: Nils Lindstrand | Photos: Claus Sjodin

Several years ago, Sydvestjysk Sygehus hospital in Esbjerg, Denmark, decided to invest in new equipment for its emergency department (ED). As part of this process, all the hospital's medical staff met to discuss which new technologies would benefit their patients most and how their investment could best improve hospital efficiency. The solution they came up with was a completely new concept, based on state-of-the-art CT scanning technology and the optimal way of using it.

"We are very proud today of how we have managed to change the logistics of this hospital and the way doctors work together," says Christian Christiansen, MD, Head of the ED.

Based on these discussions, the hospital came to the conclusion that the only way it could afford to buy the very best equipment was to improve cooperation between staff. "It became clear that there was no way the hospital could find enough money to buy everything that every specialist or department would like to have," says Christiansen. "We realized that we had to figure out how to change the way we worked from a wider perspective."

The staff concluded that the key was to provide emergency patients with the correct care from the very start. Instead of sending patients to a ward, or even back home with a letter asking them to return the following week, the hospital saw an opportunity to do things properly from the word go. Christiansen continues: "We realized that if we had the option of scanning every patient coming into the ED, we could give them the correct treatment in the right place and by the right specialist."

This approach would also enable staff to decide at a very early stage whether a patient could completely avoid a stay in hospital and, in fact, be discharged with the good news that their medical concern was a false alarm. To facilitate this, the new scanner would need to be able to work with every patient coming into the ED – irrespective of the clinical question, patient age, or pre-existing illnesses such as renal insufficiency or cardiac instability. Ultimately, this way of organizing the ED should result in a very efficient hospital and higher quality patient care.

To test whether this idea could be implemented, the staff created a model with a CT scanner and peripheral technical equipment in the basement

of the hospital, and used it to perform simulations. The results were encouraging and the process of reorganizing and installing the new equipment was continued.

### Minimal patient movement and smooth cooperation

Today, if there is an indication, every emergency patient at the hospital can receive a CT scan just a few meters from where they are taken out of the ambulance. A team of medical staff decides on the most appropriate treatment, and the patient is either discharged or taken to a specialist ED ward nearby to receive that treatment. The layout of the ED is designed to minimize the distance the doctors have to travel to the patient, and to facilitate cooperation between staff. Indeed, cooperation is very much the key to success for the new ED.

"The principle is to take the doctors and equipment to the patient instead of moving the patient around," says senior surgeon Lene Guldberg Hansen, MD. "Moving patients around always increases the risk of something going wrong, so a better alternative is to move the doctors."

**The staff concluded that the key was to provide emergency patients with the correct care from the very start.**







Christian Christiansen, MD, uses management software to organize which patients should be discharged and which should go to a nearby ED treatment ward.

*"This part of the hospital is normally quite calm, despite the obvious pressure that work in an emergency department brings. Everything is very well organized and standardized, and everyone knows where everything is."*

Christian Christiansen, MD, Head of ED

Hansen points out that this new approach requires a change in doctors' attitudes to some extent. It was not necessarily something that came naturally to all doctors from day one. "This is not my patient" or "I'm busy on my own ward" are some of the reactions that had to

be dealt with. Overcoming this slight resistance was definitely a success story for the hospital – and one of the reasons why Christiansen says he is particularly proud of how the doctors work together today.

## Patients first

"We introduced the slogan 'Patienten först' (patients first) to provide a foundation for the new approach to our work," he says. "You may say that a slogan like this is oversimplified and superficial, but we have made it work in everyday situations. The reason it is successful is that we use the phrase all the time to make decisions about patients in every situation, every day."

The question, "What would be best for this patient right now?" may result in a call to a doctor at the other end of the hospital, asking him or her to come and help. "Today, all the doctors at our hospital are integrated into the ED's work," says Christiansen. "And, as I said earlier, we are very happy that we made this work."



Today, 70 percent of all emergency patients are treated and discharged from Esbjerg hospital within 48 hours.

The results have been very clear. In national Danish hospital reports, Sydvestjysk Sygehus has gone from “somewhere toward the bottom” to third place in terms of patient satisfaction.

Today, 70 percent of all emergency patients are treated and discharged within 48 hours. Before the new scanner and workflow, patients were usually transferred to a ward and eventually examined to establish what kind of treatment they needed. Now, they no longer have the unnecessary wait for examinations or treatment.

Radiologist Martin Weber Kusk provides an example: “Instead of giving a patient a preliminary examination and then a doctor’s appointment two weeks later, we can establish what needs to be done very quickly and, in many cases, implement this within a day or two. This means higher hospital efficiency – and two weeks less worry for the patient.”

## Efficiency and safety boost patient satisfaction

The hospital’s decision to invest in a high-quality and high-capacity CT scanner like SOMATOM Force has thus paid off in a multitude of ways. Nevertheless, Guldberg Hansen also mentions the fact that the Force requires a lot of knowledge and skills to achieve a good result: “This scanner uses advanced technology and provides incredible amounts of information. Compared to older technology and routines, it needs staff who are open to change and can adapt to new workflows and technology to draw optimal conclusions from the information delivered by a CT scan. This gives hospitals the opportunity to become extremely efficient, resulting in safe and satisfied patients.”

The hospital’s SOMATOM Force allows staff to perform, for example, cardiac examinations of virtually any heart rate due to the ultra-fast temporal resolution of 66 ms, or free-breathing examinations of the lung due to the high pitch mode. In addition to this, dose is always taken into consideration: The SOMATOM Force keeps this to a minimum with low-kV imaging and two powerful 120 kW generators.

Sydvestjysk Sygehus is a medium-sized regional hospital in Denmark. The ED has a daily volume of about 40 to 50 patients, all of whom can be scanned just seconds after entering the depart-

ment. The maximum number of patients so far has been 200 in one day. Every patient spends about five minutes in the scanner room. “This part of the hospital is in fact normally quite calm, despite the obvious pressure that work in an emergency department brings. Everything is very well organized and standardized, and everyone knows where everything is and what to do in any given situation,” says Christiansen.

The SOMATOM Force was installed in April 2015. “This was a happy day for the hospital,” he says, smiling. In addition to the success for the ED in terms of patient satisfaction and general efficiency, the scanner is also used for non-emergency patients when the ED is not using the equipment to full capacity. The use of the scanner is also constantly being developed in terms of the type of patients and medical conditions that are analyzed. “We use a continuous improvement strategy,” says Christiansen. Innovations that optimize clinical pathways with the use of the scanner are a key part of this work. ●

**Nils Lindstrand** has been working as a science writer and journalist for more than 30 years. He is based in Stockholm.



**Martin Weber Kusk, Lene Guldberg Hansen, MD, Christian Christiansen, MD (from left to right):** The SOMATOM Force, installed in April 2015, has made the hospital extremely efficient, which results in safe and satisfied patients.

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# Making Mammography More Comfortable for the Patient – and More Precise

Mammography can be a source of anxiety for the patient. In Denmark, one university hospital is putting great emphasis on making breast examinations more comfortable, while at the same time enabling more personalized care with improved diagnostic accuracy.

Text: Niels Anner | Photos: Robert Wengler

**A** quiet, friendly atmosphere pervades at the hospital. As is to be expected, many women who are cared for at the Department of Mammography at Odense University Hospital are still nervous or even frightened, according to radiographer Julie Hauge Andersen. Some patients find the compression of the breast during the examination extremely unpleasant, while others fear that the findings could indicate a malignant tumor. Hauge Andersen and her colleague Melika Khanzadeh know that good communication is key in these situations. They explain the examination to the patient and help them understand that the compression of the breast is crucial in order to obtain precise X-ray images. “We explain that the quality of the diagnosis depends on a very clear image,” says Khanzadeh. While communication with the patients is vital, the department has also acquired new technology to help enhance the patient experience as well.

## Full focus on the patient thanks to a simplified workflow

According to Hauge Andersen and Khanzadeh, they have already seen a number of improvements since the new MAMMOMAT Revelation system was installed. A simplified workflow and

improved image quality have made the work of the radiography team easier. Faster results and a smooth transition from 2D mammography to 3D breast tomosynthesis have saved time, says Khanzadeh: “And that is time that we can spend on the patient and making sure the breast is correctly positioned.” Optimizing the workflow therefore not only provides benefits for the department as a whole, but also helps contribute to enhancing the patient experience.

## Optimized compression adjusted to the individual breast

What is vitally important, the radiographers explain, is that the patients feel as comfortable as possible. The flexible height adjustment of the new system helps the facility to enable a more personalized and comfortable examination. Patients notice a big difference when it comes to breast compression, which many find uncomfortable. The new compression paddles with soft edges reduce the pressure on the muscles. “Many patients have told us that they noticed the difference right away,” says Khanzadeh. She adds that it is also easier to position the breast with the hand, as there is more room to remove the hand with the rounded paddles. Patients appreciate the gentler compression that the system



More comfortable mammography screenings: Radiographer Melika Khanzadeh demonstrates the MAMMOMAT Revelation's patient-friendly design.



allows for. As soon as the paddle meets resistance, the compression slows down automatically and the system adjusts the pressure to the individual breast. This provides optimized image quality while avoiding unnecessary pressure.

"We can also use the same compression paddle for 2D and 3D examinations," explains Khanzadeh. "This results in a reduction in the steps required and a more relaxed examination. And, because we are achieving optimal compression regardless of the patient or technician, we are able to further optimize our workflow."

### **More flexible workflows reduce the number of hospital visits**

Patient numbers are continually increasing at the hospital managed by the Danish public health system. "We have a high throughput of patients," says senior radiologist Lisbet Brønsro Larsen, MD. Every day, women with symptoms such as a lump in the breast are referred to the department for diagnosis. A variety of methods can be efficiently performed on the new system, including mammography, tomosynthesis, and biopsy, and are used to support an accurate diagnosis. This also helps the department in deciding about and scheduling further diagnostic examinations, such

as ultrasound. "The use of tomosynthesis especially will make our work processes more flexible in the future. And patients will not require as many hospital visits," explains Larsen.

### **Higher image quality at a reduced dose level**

It seems entirely natural to the senior physician that the hospital should use the latest imaging technology. Larsen was already a front-runner over ten years ago when digital mammography had its breakthrough: "Of course, we want to offer our patients the best, most effective, and gentlest examination, but we also want to contribute to the further development of clinical diagnostics. MAMMOMAT Revelation offers better image quality than all the previously used systems," Larsen says. The system acquires the tomosynthesis images by taking various projections in an angular range of 50°. As a result, the 3D images are sharper and more detailed, allowing the radiologist to see more lesions than possible with 2D. Furthermore, radiation dose can be reduced by up to 30 percent in 2D mammograms thanks to the software-based anti-scatter solution called PRIME Technology.

### **Integrated breast density assessment for personalized diagnosis**

Once staff are completely familiar with the new system, the plan is to keep introducing additional solutions to further help customize workflows and enable more personalized examinations. Breast density, which is different in every woman, is one example. It is more challenging to image patients with dense breasts. Knowing the breast density can help plan further diagnostics, such as tomosynthesis. With the system, it is now possible to obtain breast density measurement automatically, directly on the acquisition workstation screen. This will help the hospital adapt its workflows. For patients with a high breast density, for example, they will perform tomosynthesis right away. In the past, the patient would have had to schedule another appointment. The hospital will soon adapt its policies accordingly. This development is an advantage for both patients and staff, saving time and providing a diagnosis sooner.

### **Advanced diagnostics in one system**

For Lisbeth Brønsro Larsen, the increased diagnostic accuracy provided by tomosynthesis is a significant benefit. Thanks to the system's



*"Especially the use of tomosynthesis will make our work processes more flexible in the future. And patients will not require as many hospital visits."*

Lisbet Brønsro Larsen, senior radiologist



Senior radiologist  
Lisbet Brønso  
Larsen, MD, and  
radiographer Melika  
Khanzadeh with the  
new MAMMOMAT  
Revelation scanner  
at Odense Univer-  
sity Hospital.

50-degree wide angle, the facility can achieve a high depth resolution, allowing for lesions in dense breast tissue to be detected that are not seen on 2D mammography. With the new system, Larsen's team can also perform biopsies under the guidance of tomosynthesis. This provides great benefits for biopsy targeting, especially when it comes to microcalcifications, which are often small and difficult to biopsy accurately. These services were not previously offered by the department, so patients needed a further appointment in another department, such as MRI. The tissue samples can also be scanned during the same biopsy procedure. With other systems, the tissues needed to be scanned with a different system, adding extra time to the examination. The radiologist and technician can stay with the patient now during the entire procedure and the time the breast is under compression can also be reduced. "The tomosynthesis biopsy examination is extremely accurate and the workflow is easy," says Melika Khanzadeh. "As biopsies can be very stressful for the patients, it's a great solution for us and it reduces the time under compression."

*"The tomosynthesis biopsy examination is extremely accurate and the workflow is easy."*

Melika Khanzadeh, radiographer

A further innovation for Larsen and her team is the possibility of contrast-enhanced X-ray imaging. She plans to carry out a study on functional imaging this fall with selected patients who are being treated for a tumor. The new technology will replace some MRI examinations in future so that patients no longer need a separate hospital visit, explains Larsen. These new multifunctional devices reduce patient waiting times, with their associated anxiety, and, at the same time, enable a more precise diagnosis. ●

**Niels Anner** is an independent journalist based in Copenhagen. He writes on business, science, technology, and society in Northern Europe.

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Impressed by the 3.0T  
MAGNETOM Vida MRI  
scanner's usability:  
Radiologic technologist  
Sarah Moritz.





# Light at the Start of the Tunnel

Thanks to a state-of-the-art magnetic resonance imaging (MRI) scanner, Aarau Cantonal Hospital has been able to broaden its diagnostic spectrum, speed up the scanning process, improve working conditions, and make exams more comfortable and convenient for patients. The hospital's radiologists are now fully equipped to meet the challenges of the future.

Text: Philipp Grätzel von Grätz | Photos: Philip Frohwein

**H**alf-way between Basel and Zurich, the 680-bed Aarau Cantonal Hospital (Kantonsspital Aarau or KSA) is one of the three biggest non-university hospitals in Switzerland. But until recently its three MRI scanners had been giving the hospital a veritable headache. Even though the two 1.5-Tesla (T) and one 3T machines were scanning without a break, waiting times of four weeks or more had become a source of annoyance and frustration, even for in-house referrers. The problem of space had also become acute: "The situation was intolerable, particularly for parents and their children. This also rubbed off on staff," explains Professor Thomas Roeren, Head of Radiology at KSA.

## Closing diagnostic gaps and optimizing screening processes

Against this backdrop, it was clear that the hospital would have to increase its capacity by procuring a fourth MRI scanner. "But it wasn't just about increasing capacity," says Alexander Cornelius, MD, Deputy Head of Radiology and Senior Consultant in charge of MRI. "We would have been able to reduce waiting times with any scanner. But we also wanted to close gaps in our diagnostic capabilities, as well as optimiz-

ing workflows to give patients, particularly children and inpatients, greater comfort and convenience."

KSA therefore opted for a truly high-end piece of equipment, the new 3T MAGNETOM Vida MRI scanner from Siemens Healthineers. It went into operation in April 2018. "The scanner has integrated tablet control, which means that staff can accelerate workflows and thus be closer to the patient and don't have to devote so much attention to the system itself," adds Cornelius.

## Greatest benefits for children, older people, and anxious patients

Radiologic technologist assistant Sarah Moritz is full of praise for the scanner's usability. She's particularly impressed by the dockable table with eDrive assistance: "We used non-motorized gurneys before, and had to move inpatients four times. Now we position them directly on the MRI table in the preparation room, where we can already arrange any masks, coils, and drips correctly. So we only have to move them twice." In addition, the table is equipped with motorized assistance so that even heavy patients can be



Sarah Moritz adjusts the scanner's innovative head coil.

effortlessly moved to and from the scanner. While one patient is being scanned, the next patient is already being prepared on a second table. This expedites the process even for patients under anesthesia. "Doing that systematically would enable us to scan twice as many patients as previously, provided anesthesia had the necessary staff," says Cornelius.

Moritz explains that three groups of people benefit particularly from the new scanner: Children, older people, and anxious patients. Patients who are prone to anxiety are helped by the fact that the scanner's 70-centimeter wide opening is illuminated, "which makes it appear even wider, meaning fewer problems for claustrophobic patients," Moritz says. "We've already had patients we couldn't work with on the other scanners who are okay with the Vida." The innovative

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## "Performing at university level in radiology"

With 35 physicians and around 100 additional staff, Aarau Cantonal Hospital (KSA) boasts one of the biggest departments of radiology in Switzerland. It offers the entire range of radiological diagnosis. Every year, its radiologists and radiologic technologists perform a total of around 120,000 exams of all sorts on both in- and out-patients. In 2017, around 11,000 of these were MRI scans. In the future, this figure is set to increase to 15,000 a year. The department's main areas of focus are intracranial and musculoskeletal MRI. However, it also offers special exams such as breast MRI and oncological diagnostic MRI imaging of the liver and prostate. "At KSA, we aspire to perform at university level in radiology," says Head of Radiology Professor Thomas Roeren, MD.

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head/neck coil, which can be tilted 9 or 18 degrees and ensures that this challenging region is automatically and optimally shimmed. This makes a particular difference for older people. "We used to have to take a lot of care to give them the extra cushioning they needed. Now, we simply tilt the coil. This makes things more comfortable, especially for older women who often have problems with their spine. There are some patients we only scan on the new system because of its head/neck coil."



Above: Professor Thomas Roeren, Head of Radiology at Kantonsspital Aarau. Below: Alexander Cornelius, MD, Deputy Head of Radiology and Senior Consultant in charge of MRI.



## Positive feedback, even from very critical parents

The patients for whom KSA's new MRI scanner makes the biggest difference are children (who are often intubated) and their families – for several reasons. For one thing, the new room arrangements and the dockable table greatly improve workflows: “Almost monthly, I used to get complaints from families because scanning required many steps and coordination was often difficult. Everyone was frustrated,” reports Roeren. Since installation of the new MRI, not only have there been no more complaints; there has even been praise. Roeren is thinking particularly of Alina, a little girl with early childhood brain damage who needs regular MRI scans: “We used to have a lot of discussions with her mother. Now we only get positive feedback.”

But in addition to the space arrangements, the MRI technology itself also makes a difference. For children who need a whole-body MRI scan every six months following cancer, larger areas of the body can be covered thanks to the large  $55 \times 55 \times 50 \text{ cm}^3$  field of view. “This allows us to complete the scan for metastasis in two steps taking less than 20 minutes, and we're often finished before the child starts moving,” says Cornelius. One child who has benefited from this is Alessia, a girl who needs regular scans because of a lymphoma.<sup>1</sup> In the future, it might even be possible for her to have scans without intubation. It remains to be seen whether the improved image quality will allow imaging to be done without contrast agent.

## Liver and heart patients can breathe easy

The new scanner marks a qualitative leap in the diagnosis of liver tumors. As Moritz explains, this applies in particular to the dynamic phase of tumor imaging with contrast agent: “We used to do a prescan with 20 seconds of instructed breathing before injecting the contrast agent, and then another three 20-second sets of instructed breathing in relatively quick succession. The resulting images were often blurred. Now we can do the entire sequence in only a few minutes without instructed breathing.”

This kind of imaging with free and unrestricted breathing is possible thanks to the new sensing technology of the MAGNETOM Vida's Compressed Sensing GRASP-VIBE.<sup>2</sup> According to Cornelius, it helps not just when it comes to

## MAGNETOM Vida's BioMatrix technology

Thanks to its innovative BioMatrix technology, MAGNETOM Vida better accounts for differences from person to person to provide consistent quality independent of patient or user. The scanner is based on a modern MRI platform that, thanks to a new magnet, larger field of view, high gradient power, better software with new applications, and easier access to postprocessing, boosts diagnostic accuracy, speeds up examinations, and improves the signal-to-noise ratio. Among other things, sensors in the table automatically capture respiratory signals, accelerating the workflow for respiratory triggered examinations. The BioMatrix head/neck coils further allow automatic optimization of image quality in areas that are especially challenging for MRI, like the neck area. Additional features of BioMatrix, including semi-automatic positioning of the patient on the basis of stored body models, can make the patient positioning process up to 30 percent faster. An easy-to-move, motorized, dockable MRI table greatly simplifies the procedure for obese, immobile, and trauma patients.

perfusion scans of the liver, but also with other scans where respiratory movements are relevant: “Compressed Sensing is an enormous advance, especially in terms of cardiac imaging, which in some cases used to involve patients having to hold their breath twelve times. Now, they can breathe freely.” ●

**Philipp Grätzel von Grätz** is an independent journalist and editor based in Berlin who covers medical and technical topics.

<sup>1</sup> MR scanning has not been established as safe for imaging fetuses and infants less than two years of age. The responsible physician must evaluate the benefits of the MR examination compared to those of other imaging procedures.

<sup>2</sup> Compressed Sensing GRASP-VIBE for other regions than liver is not for sale in the U.S.

Intended Use: Compressed Sensing GRASP-VIBE (GRASP = Golden-angle Radial Sparse Parallel MRI) is intended to be used in dynamic and/or non-contrast liver examinations to support patients who cannot reliably hold their breath for a conventional breath-hold measurement.

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# Making CT Child Friendly in London and Stockholm

Great Ormond Street Hospital for Children (GOSH) in London and the Astrid Lindgren Children's Hospital in Stockholm have developed new strategies for dealing with the most difficult diagnostic challenges – small children who are scared or anxious and cannot just be told to lie still during a scan.

Text: Linda Brookes and Nils Lindstrand | Photos: Andrea Artz and Lasse Burell



**E**very year, over 250,000 children from all over the UK and overseas come to GOSH in London for its wide range of pediatric health services and high-quality facilities. In the radiology department, which performs around 57,500 exams per year, the priority is to get the right technology, says Catherine Owens, MD, consultant radiologist at GOSH. But putting patients and their families at ease by creating an age-appropriate, child-friendly environment in the department is not regarded as just “frills”, she stresses.

“By minimizing patient trauma and getting diagnostic images in small children who are often not very cooperative, we are able to maximize image quality and output,” Owens explains. “By creating a welcoming environment, we have also increased the numbers of patients scanned

and the numbers of patients having scans without sedation or anesthesia.” A “win-win” situation is how Owens describes it.

Most of the patients who come to GOSH will return for scans several times over many years, so it is very important to give them a positive experience with their first scan which does not leave them traumatized and refusing to have another exam on their next visit. Owens emphasizes, “It is cumulative exposure to both radiation and to personalities and structures in the department.” She and her colleagues create as positive an experience as possible by preparing patients and their parents for their visit beforehand, by training staff to interact with children, through special decorations in the exam and waiting rooms, and by use of distraction techniques.



## Distraction works

Having staff at GOSH who are used to dealing with children and are able to put them at ease, particularly when using the scanner, is key. Owens says, "There are popular staff members whom the children may only see once a year, but it has a huge impact on them to see friendly faces – it makes them feel happy and relaxed."

The GOSH radiology department also works with hospital play-specialists, who sit with patients and help them understand the process ahead of time. Children can touch the scanner and the controls, and operate them without exposure. "This is especially valuable for more nervous children, such as those with learning disabilities, autism, or challenging behaviors," Owens notes.

Because CT is a very fast examination (only 2–3 seconds), the main part of making the child feel comfortable is getting them into the exam room. For a child having a CT scan at GOSH, the fun starts in the waiting room, where there is an interactive projection on the floor with motion tracking, so that when anyone walks on it, bubbles appear around their feet. "It is incredibly pretty and a very clever way of introducing children to the room," Owens notes.

The exam room itself is not so large that it is intimidating, nor so tiny that it looks like it is all one big machine, Owens explains. There are a lot of different colored lights around the room, including lights in the ceiling at the periphery that the child can change using an interactive pad. There is wall art, including a projection

At Astrid Lindgren Children's hospital in Stockholm, an audiovisual display helps to make kids feel comfortable before a scan.



Having a welcoming environment in the scanning area created a “win-win” situation for patients and the medical team at GOSH.

panel of an underwater scene showing coral and rocks, with fish that move, and a ceiling projection of swimming turtles above the scanner. To get children to remain completely still in the scanner, several different immobilization and/or sedation techniques are available. Children aged under 2 years are wrapped in a blue padded blanket to make them feel comfortable. There are also plenty of cuddly toys that can be placed on the scanner to distract the child during the process.

At GOSH, parents accompanying the children are very important in distracting the child. The hospital staff will conduct discussions with them in advance of the visit about what to expect and what they can do when they arrive. They can bring in an iPad or other tablet or their own DVDs to play cartoons for the child during the scan

(‘Peppa Pig’ is popular!). The parent can hold the tablet or it can rest in a specially constructed frame that the child can hold.

Many mothers bring cellphones preloaded with music and sing along with their children. Owens notes that GOSH patients come from a wide range of multicultural backgrounds and a number have traveled from overseas. On-site translators are available, but often they are not needed, as many of the children are happy just listening to music or watching cartoons without sound, she says.

*“By minimizing patient trauma and getting diagnostic images in small children who are often not very cooperative, we are able to maximize image quality and output.”*

Catherine Owens, MD  
Great Ormond Street Hospital for Children, London





Owens and her colleagues have shared their experience with other hospitals worldwide, including representatives from the Astrid Lindgren Children's Hospital, which set up its own pediatric CT unit. The new scanning room design worked, and not only for the children.

## Projections, cartoons, and scanning

The patients at the scanning center at Astrid Lindgren Children's Hospital are often very small, some of them just babies. They move, they refuse to lie down on the scanning table, or simply won't go near the impressive, but somewhat scary, piece of technology.

"When we moved Astrid Lindgren Children's Hospital to the new hospital complex where we are today, we realized we wanted to do something drastic to convert the scanning room into a friendly environment for children," says Lena Gordon Murkes, MD. "It was clear that the latest in scanning technology gave us a chance to get good images even with children as patients, but we still needed to get them to cooperate and to be calm for a few minutes".

Gordon Murkes knew of a company in Sweden that is developing audiovisual technology for commercial and educational use. "I phoned them up, and we started collaborating to create a scanning room that would invite and calm children and parents instead of scaring them," she explains. Cartoons, light effects, and video films are projected onto walls or complex backgrounds, using very powerful projectors.

By combining a bit of modern magic with committed professionals, the challenge has been turned into a major success. The rest of the room is dark, and the gantry is covered with images of stars, rainforest backgrounds, or simply dreamlike flickering lights. For small children, popular cartoons are screened on the ceiling. And it worked – it really worked.

At the Astrid Lindgren Children's Hospital, Gordon Murkes says, "We had one boy about ten years old who was autistic. He got very anxious when he was about to lie down on the scanning table, and got quite aggressive in his agitated state. But when we showed the popular children's cartoon 'Babblarna', originally created for children with reading or communication disabilities, this young man became quite calm, and totally focused on the story played out in the cartoon."



*"The audio-visual display gives our little patients something beside the health issues to talk about. This provided a much more calm, positive situation."*

Lena Gordon Murkes, MD  
Astrid Lindgren Children's Hospital, Stockholm

Gordon Murkes says, smilingly, that the old challenge of getting the children to lie still during the scanning procedure has been replaced by the problem of making them leave. "If we show them one episode of a popular cartoon, they want to watch all the episodes before they have to go home."

"We also saw the positive effect it had on the parents," says Lena Gordon Murkes. "They came in, obviously very anxious about what the scan would show, and nervous about the scanning procedure as well. The audiovisual display gives them another focus, and something beside the health issues to talk about. This provided a much more calm, positive situation overall." ●

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**Nils Lindstrand** is an independent business and technology writer based in Stockholm, Sweden.

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# A Pioneer's Way to Improved Patient Care and More Efficiency

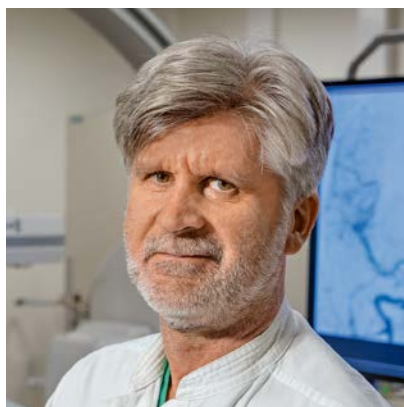
The evolution of interventional radiology (IR) is marked by numerous technical milestones. These include angioplasty, embolization therapy, and advanced image guidance. The latest innovation, however, is administrative in nature. Ghent University Hospital in Belgium, has set up a stand-alone interventional radiology department. As a result it reports reduced length of stay and increased patient satisfaction.

Text: Erika Claessens | Photos: Christophe Vander Eecken



*"I hope I have shown them the way forward."*

Luc Defreyne, MD, PhD  
Professor of Interventional Radiology and Head  
of the Department of Vascular and Interventional Radiology,  
Ghent University Hospital



**L**ocated in one of Belgium's Dutch-speaking provinces, the Ghent University Hospital buildings are dispersed over a vast area of 42 hectares in the southern part of the city. Luc Defreyne, MD, PhD, Professor of Interventional Radiology and Head of the Vascular and Interventional Radiology Department (VINRAD), was previously dedicated to providing clinical treatment for other internal departments. He created an autonomous IR Department where patients receive high-quality, cost-effective care.

### Building a clinical home for IR

Defreyne faced a number of challenges while setting up the department, but also notes that the change benefits the hospital and its patients: "Due to its size, the hospital is divided into eight departmental sectors to ensure better overall management. Unfortunately, the IR Department was caught between two sectors. Obviously we were part of the Supporting Departments sector, but as we cover a lot of critical-aid interventions for the intensive care unit and the emergency unit, we were also part of the Critical Services sector. As such, we were never considered an autonomous entity – more like a supplier of diagnostics for other doctors and departments. This meant we were financially dependent on these other sectors."

### Meeting the challenge

The push for independence developed gradually and due to various circumstances. "First, we

needed dedicated staff. In IR, we treat patients from head to toe. We perform minimally invasive interventional therapies for a wide range of pathologies. These include vascular surgery, neurological interventions, interventional tumor treatment, and many critical interventions in cases such as upper gastrointestinal bleeding", says Defreyne. "It was becoming harder to find nurses willing to work at night – often for many hours – during emergency interventions. Most were seeking a better work-life balance with a nine-to-five job in the radiology department, but for emergency interventions, I need a dedicated team with critical-care expertise. Having the scope to build that team was one of the reasons why I wanted an independent department."

### Make a statement

Second, Defreyne felt the need to make a statement about IR and the role of radiologists in care pathways. He wanted to show the administration board how his interventional treatments reduced length of stay, and consequently benefited hospital revenues (in Belgium, government reimbursement depends on the length-of-stay rate per hospital). Defreyne says he also wanted to make the board understand that radiologists have a great deal of expertise and are just as capable of looking after patient healthcare as other physicians. Finally, he says, it was definitely also a strategic decision. "It would provide me with a budget to invest in new equipment. As head of the IR Department, I could manage costs and improve patient care."



*“Providing high-quality, cost-effective care will become increasingly important as we move toward a value-based healthcare environment.”*

Luc Defreyne, MD, PhD  
Professor of Interventional Radiology and Head of the Department  
of Vascular and Interventional Radiology, Ghent University Hospital

Defreyne had to convince the Administration Board that autonomy was necessary. “IR requires a lot of high-tech equipment. It helped that I could make a strong business case with detailed information on interventional procedures and the hours worked on a single intervention. Every procedure was analyzed in terms of hours and costs. It’s a lot of paperwork, but it’s worth it. IR is the future and robotic surgery is up and coming. It’s what makes a hospital attractive to patients.”

### **Positive patient outcomes**

In Ghent, Defreyne also says the IR department achieves more positive patient outcomes. “We are no longer just performing a medical act and sending the patient back to the surgeon who requested the intervention. We now decide ourselves on the treatment and have the informal consent of the colleagues involved. In the case of an aneurysm, for example, we manage the entire follow-up and schedule a post-surgery appointment. For outpatients, we also schedule a check-up after six months. My department is now well known for its professional follow-up services. This has increased patient satisfaction.” The minimally invasive nature of IR procedures reduces length of stay, and having a separate department where interventional radiologists can take primary responsibility for patient care also reduces delays associated with unnecessary consultations and handovers for admissions and discharges. In Ghent, the interventional team decides when a patient can be discharged. Defreyne says his department is known for its short waiting times. “Many scientific papers prove that IR patients are more profitable in terms of length of stay and costs than surgical patients are,” he adds.

Outside view of Ghent University Hospital





For Luc Defreyne, MD, PhD, running IR as an independent department means having a chance to make hospital processes more efficient and improve clinical outcomes.

## Happy staff and patients

The IR Department eventually received its own beds from the hospital's surgeon commission. This allowed it to admit its own patients, make its own clinical decisions, and provide follow-up care. Each patient benefits from a personal approach. This keeps their hospital stay to the absolute minimum. The IR Department can choose and pay for its own medical equipment and devices. Defreyne explains how this has changed things: "The intake procedure differs and the stay is shorter. The waiting times for patients are also much shorter. We now perform 1,200 outpatient consultations per year. It's a lot, and there is an upward trend. Apart from the increased patient satisfaction, we noticed our staff are happier, too, because they are now responsible for their patients as well as for their work. As part of the financial evolution, the employees now belong to the IR department, and their salaries are paid from its budget."

For Defreyne, this is a dream come true. He now has an independent IR department, with its own beds, its own dedicated staff, and its own budget. "I hope I have shown them the way forward," he says. "Providing high-quality, cost-effective

care will become increasingly important as we move toward a value-based healthcare environment." ●

### Erika Claessens

has contributed as a journalist and editor to numerous print and online publications in both Belgium and the Netherlands. Her main topics are entrepreneurial innovation and technology. She works in Antwerp, Belgium.

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# Zooming in on AI-Based Image Interpretation

While the use of artificial intelligence in radiology eases workflows, it may also lead to a better and more precise understanding of disease. Predicting the course of cancer from imaging data could become a part of clinical routine in the next few years.

Text: Martin Lindner

**M**any experts believe that the increasing use of artificial intelligence (AI) in radiology will fundamentally change the interpretation of medical images. But which scenarios are realistic and tangible? A general idea is that AI-based image processing may not only accelerate and ease standard reading workflows, but could also lead to a more exact understanding of disease. One of the most fascinating perspectives lies in the prognosis of disease progression based on hitherto unused imaging information.

## Leveraging AI for imaging workflows and reading

One example of the use of AI is provided by chest imaging. Many algorithm-based work steps have already been integrated into imaging results today or are at least conceivable in the future as routine solutions, says Michael Lell, MD, Professor and Chairman in the Department of Radiology and Nuclear Medicine at Klinikum Nuremberg, Germany. For example, image reconstructions from imaging data and radiological reporting are facilitated considerably by AI. Besides this, lung nodules and tumor foci can be precisely measured, lung volumes automatically quantified, and calcium scoring sped up.

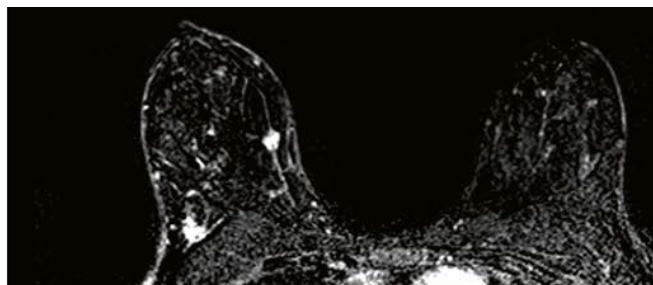
Overall, machine algorithms support comprehensive chest imaging, confirms Razvan Ionasec, Product Manager Artificial Intelligence at Siemens Healthineers. Thus, the latest software technologies are in a position to independently recognize and to present color-coded anatomical structures and organ contours (e.g., lung lobes and the aorta) – something that makes multi-organ imaging simpler and more intuitive. Presumably such approaches could also allow multimodal, whole-body scans to be automatically evaluated in the future, says Ionasec.

Many of today's AI applications have assisting functions for radiologists and aim to facilitate cognitive steps in the interpretation of images, to avoid careless mistakes, and to improve the structure of the reading process. An obvious common scenario, for example, would be to have intelligent algorithms sort the ever-larger number of images according to abnormal findings and to offer the physician a work list prioritized by level of urgency, explains Lell.

## Image-data based phenotyping of disease

However, the potential uses of AI go well beyond merely more efficiently shaped workflows. The approach also opens up new paths toward personalized imaging and therapy,





**Proposed diffusion-weighted, high-b-value imaging for noncontrast breast cancer imaging.**  
 Courtesy of R. Mann, Radboud Nijmegen, The Netherlands

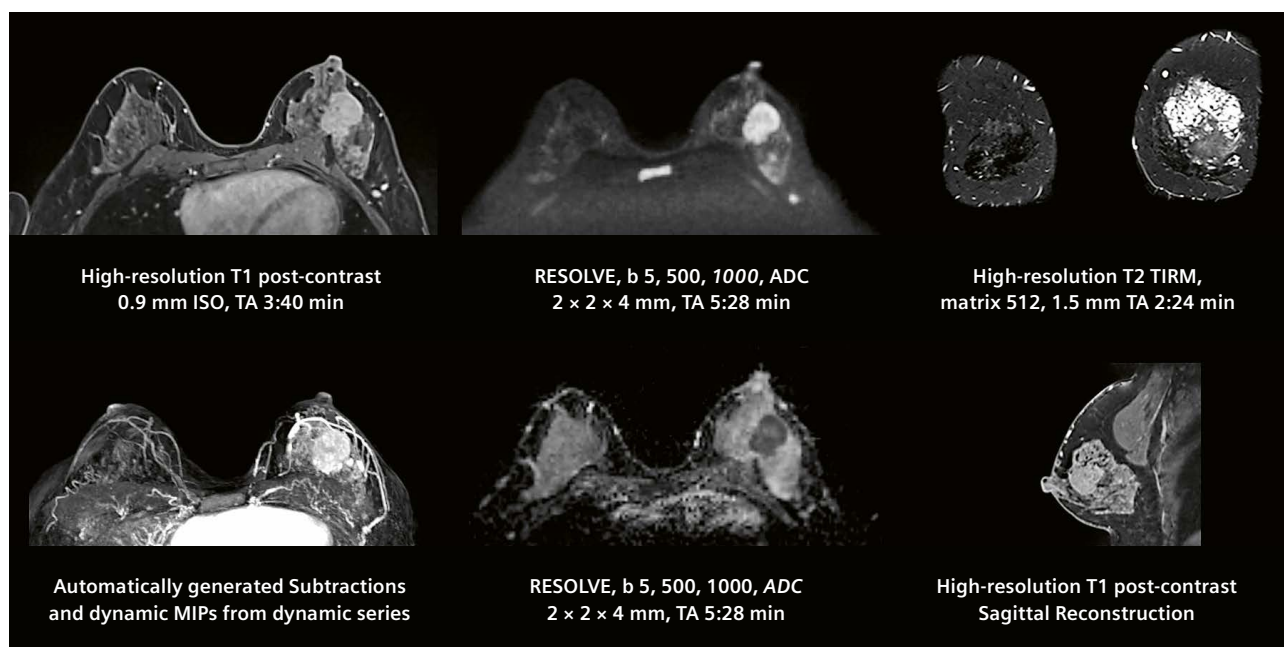
emphasizes Georg Langs of Computational Imaging Research Lab at Medical University of Vienna, Austria. One key to this is quantifiable imaging biomarkers (extracted from radiomics data), with which disease processes can be classified more precisely and in more detail. "AI can transform overwhelming data into structured data," says Langs.

### Predicting cancer recurrence

Even more impressive is another example: Breast cancer imaging using MR. Today, radiologists already draw on various MR image characteristics to distinguish between benign and malignant lesions, for example, by the shape of the margins, the contrast enhancement, and the presence of edema.

However, such features of the MR image are usually not summarized in quantitative scores and are assessed only qualitatively. Moreover, many pieces of imaging information are just not visible to the human eye. In contrast, hundreds of mathematically definable individual imaging parameters can be evaluated with computerized analyses on a voxel base to determine, for example, signal and contrast behavior, surface morphology, and inner texture of a lesion. Using machine-learning algorithms, this may enable recognition of imaging signatures specific to a disease. This data-based approach to image interpretation is also known as radiomics.

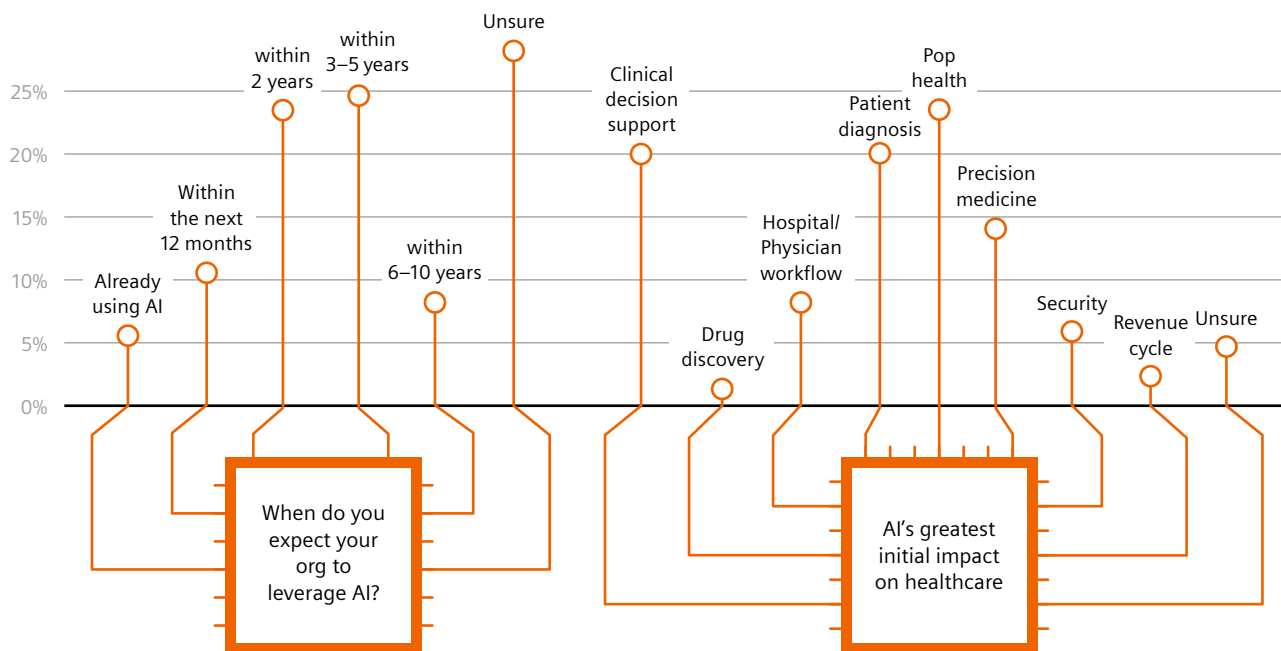
Several current studies are showing the potential of the approach. Particularly noteworthy is that even the risk of



**Comprehensive, multiparametric breast MRI in a 39-year-old female with cancer of the left breast**  
 Courtesy of AZ Sint-Maarten, Belgium

## Artificial intelligence is arriving in healthcare

Survey of 85 healthcare executives in the U.S.



Source: Healthcare IT News, <http://bit.ly/2p790oR>

recurrence of breast cancer can be estimated based on the imaging data, as is possible today with molecular genetic tests.[1] This could open up possibilities for non-invasive image-based tumor profiling in the future. However, these very promising studies are still in their infancy. In five to ten years, it will be seen which part of this hype is worth it, and which was just hype. At the same time, it is now already clear that the significance of medical images is changing, from pictures in the original sense to “data and information carriers.” The interpretation of images with the aid of artificial intelligence is likely to play a key role here. ●

### Martin Lindner

is an award-winning science writer based in Berlin, Germany. After completing his medical studies and a doctoral thesis in the history of medicine, he went into journalism. His articles have appeared in many major German and Swiss newspapers and magazines.

### References

- [1] Li H, Zhu Y, Burnside ES, et al. (2016) MR Imaging Radiomics Signatures for Predicting the Risk of Breast Cancer Recurrence as Given by Research Versions of MammaPrint, Oncotype DX, and PAM50 Gene Assays. *Radiology* 281:382-391

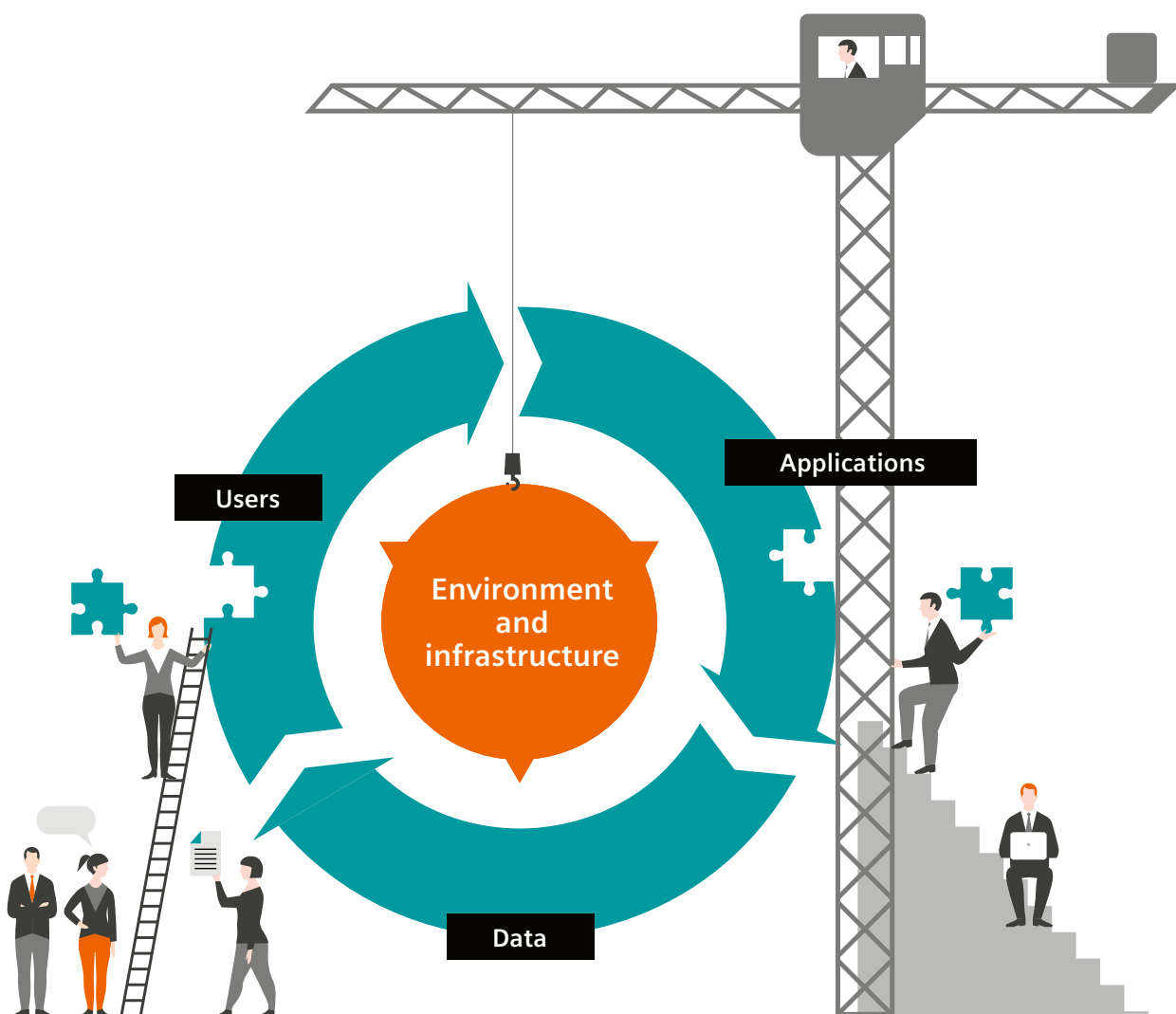
Products and features mentioned herein are under development and not commercially available. Future availability cannot be ensured.

Results and statements displayed in this article have been discussed during the European Congress of Radiology 2018 in Vienna, Austria.

# Coopetition Brings the Magic to Digital Healthcare

Ready or not – we are in the midst of what to many people still feels like “the future”. The rapid advance of digitalization is changing every aspect of our lives. Technologies such as the Internet of Things, augmented reality, blockchain, and social media are bringing about an unprecedented transformation, affecting our work in ways we never anticipated.

Text: Andrea Lutz | Illustration: Dmitri Broido



**M**eanwhile, demographic change and rapid population growth are posing serious challenges to healthcare providers and payors. Against this backdrop, you are probably asking yourself: How can I deal with constantly growing cost pressure, falling reimbursement rates, and fewer specialist staff – all while living up to increasingly high patient expectations?

The good news is that you are not alone! Healthcare providers the world over are faced with similar challenges. What is more, there is a strategy that can unite them all in the pursuit of shared growth: coopetition.

## Open environment for healthcare stakeholders

Interaction between cooperative companies is characterized by a partial congruence of interests – they cooperate in order to boost value creation for all. Applied to healthcare, this is an especially powerful concept: Every day, vast amounts of health-related data are generated in the form of images, laboratory results, pathological findings, reports, and so on. Year for year, this vast pool of data grows by 48 percent.[1] However, as long as the data is not interpreted or shared, it is mostly useless. To enable smart use of health-related data, Siemens Healthineers has created an open and secured environment for a wide range of healthcare stakeholders. They can use a range of applications from Siemens Healthineers and numerous other partners to get the most out of shared healthcare data. This Digital Ecosystem is not a product, but a concept – designed to promote innovation and collaboration along the entire healthcare supply chain. As in a natural ecosystem, partici-

pants interact and grow together. The insights they gain from their own data are complemented by additional findings flowing from the combined data pool of all the participants in the platform.

## Many of today's healthcare challenges can be overcome

If this ecosystem grows and flourishes, it will enable healthcare providers worldwide to harness the full power of a digital healthcare system: It can help benchmark performance, guide diagnosis, make treatment more precise, establish best practices faster – and much more. Well-trained pattern-seeking algorithms can roam enormous data repositories to identify trends and



### How can healthcare providers access specific applications?

A dedicated online store allows users to search for applications or to request a quotation or trial. Offerings available will include both cloud-based and locally installed deployments (on-premise applications). Users will be able to purchase and deploy applications in their setting – either by installing them locally or through a secure cloud connection. Best of all: Customers and patients benefit from an ever-expanding range of medical applications.

### What is coopetition?

There are numerous examples of problems that are easier to solve for a partner in an ecosystem than for a single provider. Depending on the situation or problem at hand, interactions between participants in the ecosystem can be both collaborative and competitive in nature, leading to the creation of new knowledge. In a flourishing digital healthcare industry, contributors become beneficiaries, and beneficiaries become contributors. This phenomenon is described as coopetition.

*“A lack of digitalization is clearly a showstopper for any department that aspires to become more efficient.”*

Johan Sjöberg, Medical Physicist, Karolinska University Hospital, Stockholm, Sweden







*"Since the introduction of our first cloud-based offerings, we have created an environment in which users leverage the insights of close to 40 million clinical dose and utilization studies from operating imaging equipment."*

Alexander Lippert, Head of Digital Ecosystem, Siemens Healthineers

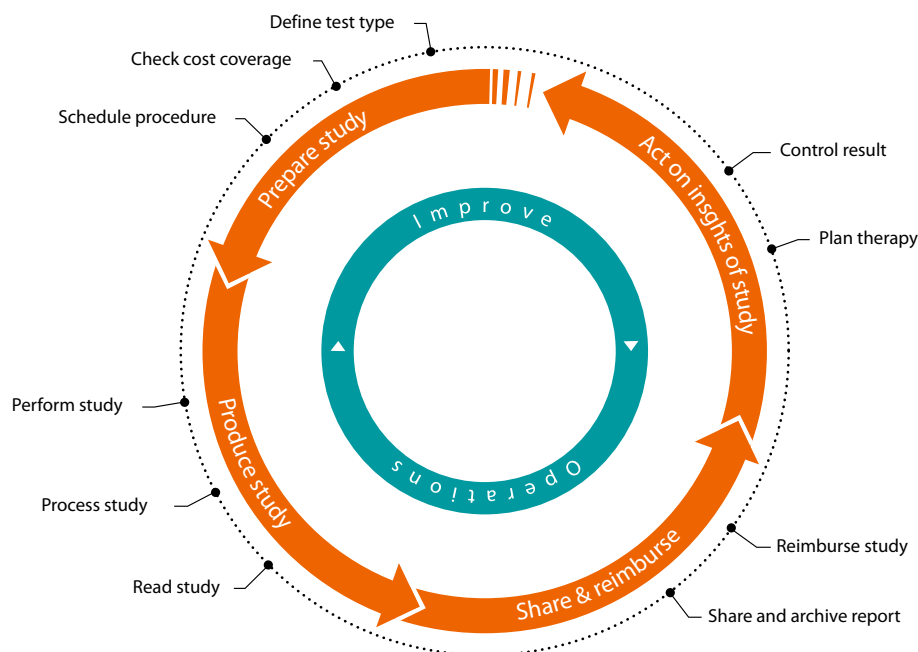
correlations that are undetectable to human observers. By leveraging the power of digitalization, many of today's healthcare challenges can be overcome. For example, by connecting their imaging equipment to a single global, cloud-based network, providers would be able to view real-time utilization data, monitor patient radiation doses, or share protocols.

Or even predict therapy response: Resistance to conventional radiation therapy is a major issue in the treatment of late-stage lung cancer, leading to relapse. The heterogeneity of tumors makes it difficult to personalize therapy. One approach to improving the accuracy of lung cancer diagnosis in order to personalize therapy is using pre-

dictive analytics and noninvasive imaging in conjunction with AI-powered decision-support tools and quantitative genomics to predict therapy response. This strategy relies on information from a wide range of different sources.

"Siemens Healthineers imaging equipment, in vitro solutions, as well as associated software and services globally cover more than 200,000 patients per hour. Healthcare providers stand to benefit immensely from combining the resulting information within an ecosystem: Instead of relying on insights gained from 500 cases, this would allow them to draw on millions," explains Alexander Lippert, Head of Siemens Healthineers Digital Ecosystem. ●

## End-to-end imaging chain offers multitude of data-based, actionable insights



## Getting everyone on board

It seems we are more than happy to trust in IT when we put our private lives online, but much less so when it comes to our professional life in the healthcare industry. Many of us are reluctant to share our data and information in the cloud, for reasons ranging from reservations about cloud-based systems in general to strategic or legal considerations.

### How do I prepare and motivate my team to embrace the benefits of digitalization?

Johan Sjöberg, Medical Physicist at Karolinska University Hospital in Stockholm, has an answer: "There will be challenges in the adoption, efficient use, and development of digital tools for some healthcare employees. However, any challenge holds the potential for learning opportunities. Fostering better digital competence in the workforce is achieved by adopting digital tools and workflows. Any tool that can be seen to create value for an employee will be used by that employee. Active training in combination with clear leadership from the organization can pave the way for quick adoption. Digital healthcare opens up opportunities for team collaboration across disciplines and sites, replacing the fragmented traditional silo-based system."

### How is data security guaranteed in an ecosystem?

Alexander Lippert, Head of Healthineers Digital Ecosystem, has an answer: "There are two aspects of data security: privacy

protection and IT security. The importance we attach to privacy protection is apparent from the fact that we earned the European Privacy Seal certification for teamplay Dose and teamplay Usage. These applications were designed to prevent patient-specific information from reaching the cloud from the outset. Our approach to IT security is equally forward-looking. We perform threat and risk analyses before developing new features. Our software is constantly subjected to penetration tests in which experts try to infiltrate our systems and identify weaknesses. In addition, the Microsoft Azure Cloud Platform provides us with a reliable and secure environment in which to aggregate and analyze all the data."

Johan Sjöberg, has an answer: "Patient outcomes are improved whenever efficiency, timeliness, accessibility to care, or patient safety are improved. Decisions informed by data are more likely to be rational as they are evidence-based rather than opinion-based. Evidence-based decision-making has better potential to generate more effective and safe care that can be delivered to patients faster."

Johan Sjöberg, Medical Physicist, is employed by an institution engaged in contractual collaboration with Siemens Healthineers.

**Andrea Lutz** is a journalist and business trainer specialized on medical topics, technology, and healthcare IT. She lives in Nuremberg, Germany.

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[1] Stanford Medicine 2017: Health Trends Report.

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# The Changing Role of the Radiologist in the Age of AI

The increasing integration of digital technologies in imaging opens up new ways of working, but also entails new tasks. In the future, radiologists may see themselves as data communicators – and work with more interdisciplinarity than before.

Text: Martin Lindner | Photo: Getty Images



**W**hile the use of artificial intelligence (AI) could transform a wide variety of medical fields, this applies in particular to radiology. For decades, medical images have been generated and archived in digital form. Now, breakthroughs in computer vision also open up the possibility of their automated interpretation. The question therefore arises: How is the role of the radiologist changing?

Of course, the effects of AI cannot be conclusively predicted. "It is not yet clear what the full or final role of AI methods, or their impact on radiologists, will be in imaging," writes James Thrall and his colleagues from Harvard Medical School in a recent position paper.[1] Moreover, the visionary potential of artificial intelligence is by no means uniformly assessed and, for example, tends to be viewed more cautiously in Europe than in the U.S.[2]



Nevertheless, most experts agree that intelligent algorithms will increasingly find their way into radiological routine over the next five to 10 years. A probable scenario is therefore that radiologists will need to adapt their methods and ways of thinking – and to work in a far more interdisciplinary way in their clinical and scientific activities than before.

### **AI will be a tool for radiologists, not a threat**

Meanwhile, the concern that diagnostic computer algorithms might soon replace radiologists has largely been put into perspective and a more realistic picture is gaining ground. “I am convinced that AI is not a threat but a tool that we can use to support our work and to improve results,” noted Bernd Hamm, president of this year’s European Congress of Radiology, in his welcome to delegates.[3]

On the one hand, automated image interpretation could prove an indispensable aid to cope with increasing workloads. According to an analysis by the Mayo Clinic in the U.S., radiologists there now have an average reading time per CT or MRI image of only three to four seconds.[4] “It is no secret that radiologists could use some help,” remarks neuroradiologist Christoph Stippich and his colleagues at University Hospital Basel, Switzerland.[5]

On the other hand, AI is also a promising research tool. Drawing on extensive image datasets, intelligent algorithms, for example, may allow noninvasive tumor profiling to predict the course of disease or the response to therapy.[6] More generally, AI could increase the explanatory power and value of medical images.



Still there are many good reasons, “why AI will not replace radiologists,” as Royal College of Radiologists informatics committee member Hugh Harvey emphasizes in a blog post.[7] The work of radiologists is by no means limited to viewing and interpreting pictures – rather, radiologically trained doctors are involved in patient care. They carry out various interventional procedures. Not least, they maintain legal responsibility for their actions.

## Embracing a mathematical mindset

In addition, radiologists are in demand as experts in order to implement AI in clinical medicine at all. While building an AI algorithm can be comparatively easy, converting an algorithm into a robust diagnostic tool is far more difficult and requires carefully annotated image databases for validation. Radiologists themselves therefore play a central role in the transformation of their discipline.

In the process, a new mindset is needed. Stefan Schönberg of University Hospital Mannheim, Germany, speaks of a “mathematical revolution in radiology.” Given the possibility of using machine algorithms to analyze multiparametric

image datasets with voxel accuracy (“radiomics”) or to correlate them with genetic information about the patient (“radiogenomics”), “it is not clear if we are still looking at images or at statistical parameters,” says Schönberg. Radiology is getting close to data science.

Radiologists may increasingly adopt the role of putting these complex data analyses into context – and conveying them to patients, as well as clinical colleagues. “I can certainly envisage radiologists as data communicators,” says Harvey. Also, the cooperation with other data-driven and AI-supported disciplines, such as genetics or pathology [8], will become all the more important the more the idea of personalized diagnostics begins to take hold as a standard of care.

## Strategic steps to take

These developments may soon be felt on a broader basis, as a recent white paper from the Canadian Association of Radiologists predicts.[9] Accordingly, AI will be integrated into the current Picture Archiving and Communication Systems (PACS), particularly for routine tasks in image reading. “In the next five years, radiologists will see more competent AI applications incorporated into PACS workflows, especially for laborious tasks prone to human error, such as detection of lung nodules on X-rays or bone metastases on CT scans.” Upstream and downstream processes in the radiology workflow, such as image data acquisition and reporting, are likely to be increasingly managed with AI algorithms as well.

For radiology as an academic discipline, this means that it will have to work more closely with IT and computer science departments in the future. Leading hospitals in particular need to invest in hardware and human capital in order to set up specialized AI laboratories, similar to other medical fields.

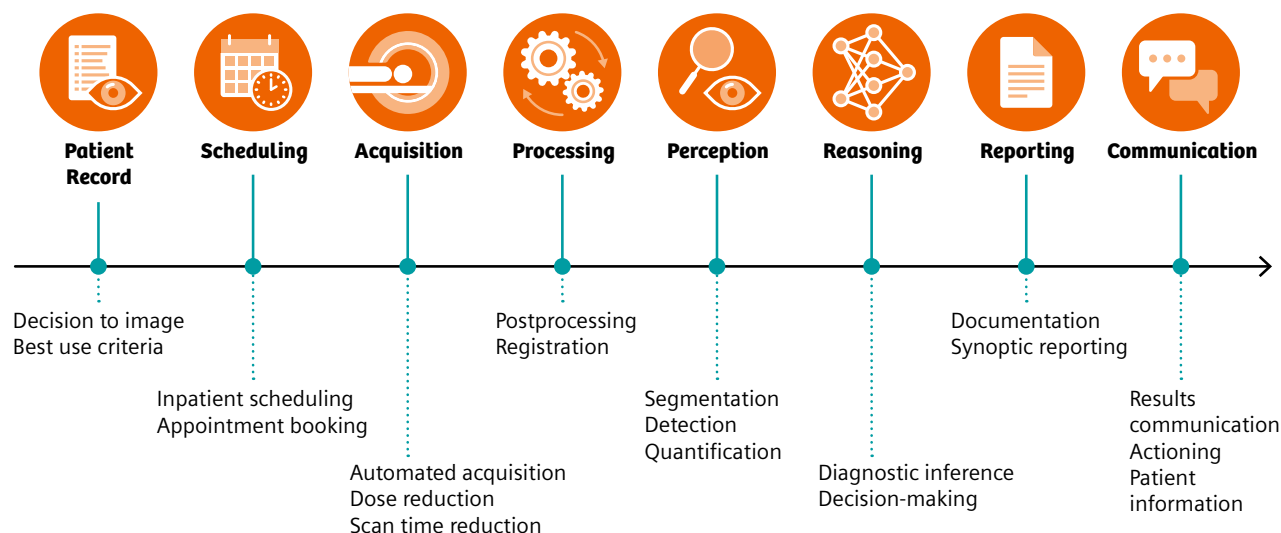
Radiological education and training will also change. “If radiologists have to learn about the physics of MRI, then I think learning about the basic principles of imaging informatics is at least as important,” emphasizes Sergey Morozov, president of the European Society of Medical Imaging Informatics.[10] While radiologists in the U.S. have been able to acquire an additional certificate as an ‘Imaging Informatics Professional’ for some time now, the area has only recently been included in the European curriculum for subspecialty training in radiology.[11]



# The radiology workflow, with examples of possible AI applications

Simplified schematic of the diagnostic radiology workflow, with examples of where AI systems can be implemented.

Source: drhughharvey



This also opens up new job profiles and career opportunities. "Once an area is recognized as important, capable people quickly populate it," notes Thrall and his colleagues from Harvard Medical School. It would come as no surprise to see the AI-savvy radiologist more frequently in the future. ●

**Martin Lindner** is an award-winning science writer based in Berlin, Germany. After completing his medical studies and a doctoral thesis in the history of medicine, he went into journalism. His articles have appeared in many major German and Swiss newspapers and magazines.

## References

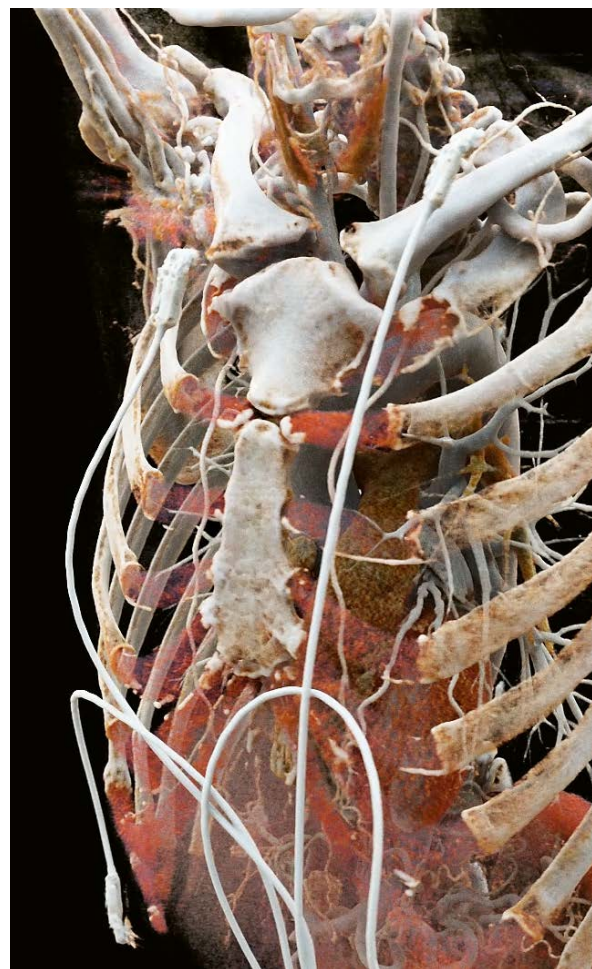
All online sources last accessed August 21, 2018

- [1] Thrall JH, Li X, Li Q, et al. (2018) Artificial Intelligence and Machine Learning in Radiology: Opportunities, Challenges, Pitfalls, and Criteria for Success. *J Am Coll Radiol* 15:504-508
- [2] Michael Walter (March 13, 2018) Are European radiologists skeptical about AI? A report from ECR 2018, [www.radiologybusiness.com/topics/artificial-intelligence/are-european-radiologists-skeptical-about-ai-report-ecr-2018](http://www.radiologybusiness.com/topics/artificial-intelligence/are-european-radiologists-skeptical-about-ai-report-ecr-2018)
- [3] Philip Ward et al. (March 8, 2018) Top 5 trends from ECR 2018 in Vienna, [www.auntminnieeurope.com/index.aspx?sec=rca&sub=ecr\\_2018&pag=dis&itemid=615650](http://www.auntminnieeurope.com/index.aspx?sec=rca&sub=ecr_2018&pag=dis&itemid=615650)
- [4] McDonald RJ, Schwartz KM, Eckel LJ, et al. (2015) The effects of changes in utilization and technological advancements of cross-sectional imaging on radiologist workload. *Acad Radiol* 22:1191-8
- [5] Hainc N, Federau C, Stieltjes B, et al. (2017) The Bright, Artificial Intelligence-Augmented Future of Neuroimaging Reading. *Front Neurol* 8:489
- [6] Aerts HJ, Velazquez ER, Leijenaar RT, et al. (2014) Decoding tumour phenotype by noninvasive imaging using a quantitative radiomics approach. *Nat Commun* 5:4006
- [7] Hugh Harvey (January 24, 2018) Why AI will not replace radiologists, <https://towardsdatascience.com/why-ai-will-not-replace-radiologists-c7736f2c7d80>
- [8] Yu KH, Zhang C, Berry GJ, et al. (2016) Predicting non-small cell lung cancer prognosis by fully automated microscopic pathology image features. *Nat Commun* 7:12474
- [9] Tang A, Tam R, Cadrin-Chênevert A, et al. (2018) Canadian Association of Radiologists White Paper on Artificial Intelligence in Radiology. *Can Assoc Radiol J* 69:120-135
- [10] [www.eusomii.pro/newsletter-2018/#medicalimaginginformatics](http://www.eusomii.pro/newsletter-2018/#medicalimaginginformatics)
- [11] [www.myesr.org/education/training-curricula](http://www.myesr.org/education/training-curricula)

# From Movies to Medicine

The images are certainly eye-catching, but that's not all. Cinematic rendering – a new type of photorealistic 3D visualization inspired by Hollywood – could transform the way physicians are delivering care.

Text: Martin Lindner | Courtesy: Kerckhoff-Klinik, Bad Nauheim and University Hospital Erlangen, Germany



**T**his novel way of reconstructing 3D visualizations from CT and MRI data may help to more efficiently prepare interventions – for example, in cardiac, abdominal, cancer, or trauma surgery patients. The approach could also facilitate communication in interdisciplinary boards and between doctors and patients.

## Finding access to the heart

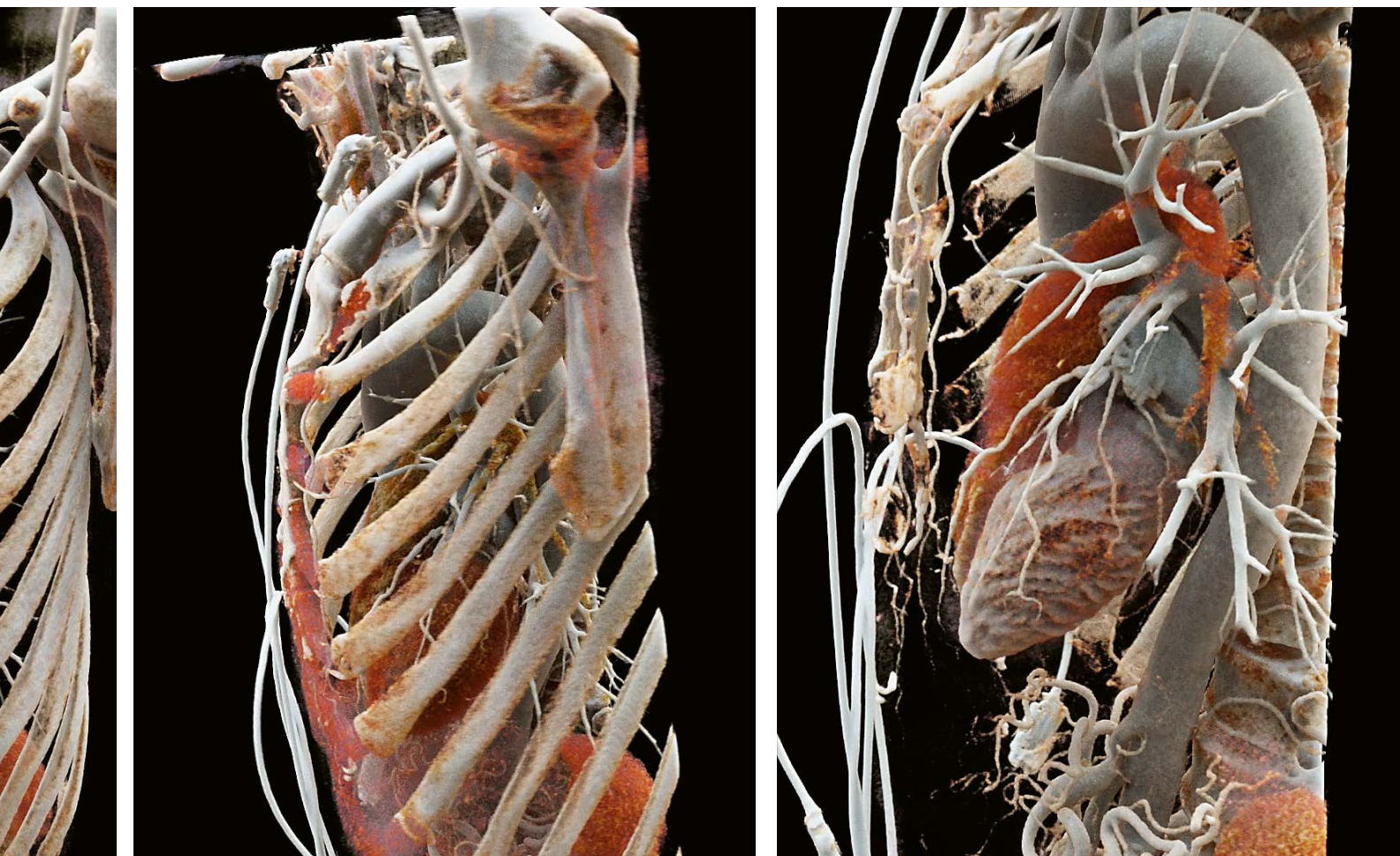
"The more vivid the imaging, the better it is for the surgeon," confirms Arnaud Van Linden of University Hospital Frankfurt, Germany. Van Linden, a cardiac surgeon, is testing cinematic rendering (CR) for the planning of minimally

invasive bypass operations. In these operations, known as MIDCAB (minimally invasive direct coronary artery bypass), an additional vascular conduit is created on the heart via a small incision in the chest wall.

"Thanks to CR, we can get a virtual look inside the chest cavity, assess the layout of the vessels, view the heart from the side or from above – and then determine the ideal access point for the operation," says Van Linden. "The images really look just like what you see later in the operation."

This realistic depiction is based on a specific image-synthesis algorithm. CR comes from the film industry (hence the name) and allows, for





Cinematic rendering provides the potential to plan minimally invasive direct coronary artery bypass (MIDCAB) surgery effectively and safely by determining the optimal intercostal access point, the location of the left internal mammary artery (LIMA) in relation to the sternum, and the left anterior descending (LAD) artery. The photorealistic representation is closer to the real-life surgical view than other imaging representation methods.

example, computer-animated figures to appear exceptionally true to life. In medicine, these image reconstructions are most often computed based on contrast-enhanced CT scans, although MRI data would also be suitable.

### Principles of cinema applied to medicine

Three-dimensional (3D) renderings are not new in imaging. In the previous standard method, known as volume rendering, an image dataset is basically illuminated by a virtual light source, in order to simulate the opacity and color characteristics of the tissue and create the impression of a 3D object. CR uses a significantly more



*"The images really look just like what you see later in the operation."*

Arnaud Van Linden, MD  
Senior Physician, Clinic for Thoracic and Cardiac Vascular Surgery,  
University Hospital Frankfurt, Germany





*“Especially in complex anatomical situations, these visualizations are helpful.”*

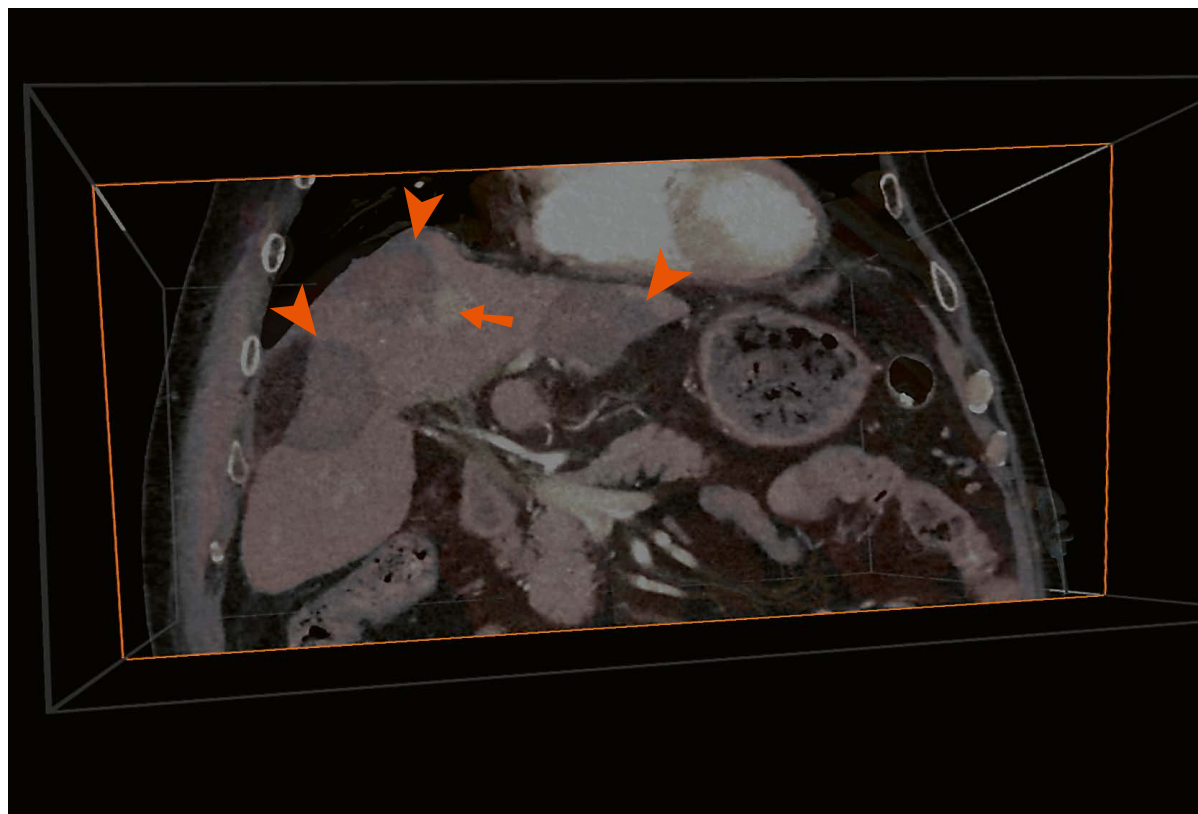
Christian Krautz, MD  
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complex illumination model, which integrates numerous light-scattering, absorption, and shadowing effects that are important for visual perception in the everyday environment.[1] This makes the images very realistic – and surgical planning easier.

The important thing with MIDCAB is choosing the right surgical path, which can go through the fourth intercostal space or, just as well, the fifth, explains Van Linden. “Sometimes the less optimal access point is chosen, and then you struggle during the operation.” With some patients, only plain X-rays are available for planning; but even with CT scans, heart surgeons occasionally have a hard time getting a precise notion of the anatomical situation. “MIDCAB works without CR – but becomes much more feasible with it,” says Van Linden. Meanwhile, shorter surgeries could also lead to cost savings and faster recovery of the patients.

Hybrid procedures performed by combined teams of cardiac surgeons and interventional cardiologists, or complex pediatric heart surgeries, could presumably also be better planned

Recurring hepatocellular carcinoma (arrow) on the edge of a previous ablation procedure (arrowhead). Left: 2D CT image. Right: CR image for improved therapy planning.



with the new visualization method, says Van Linden. Last but not least, the fact that CT coronary angiography is increasingly used as a diagnostic alternative to cardiac catheterization (so that CT data are already on hand) could make CR routine in preoperative imaging.[2]

### Quick and reliable interpretation of complex anatomy

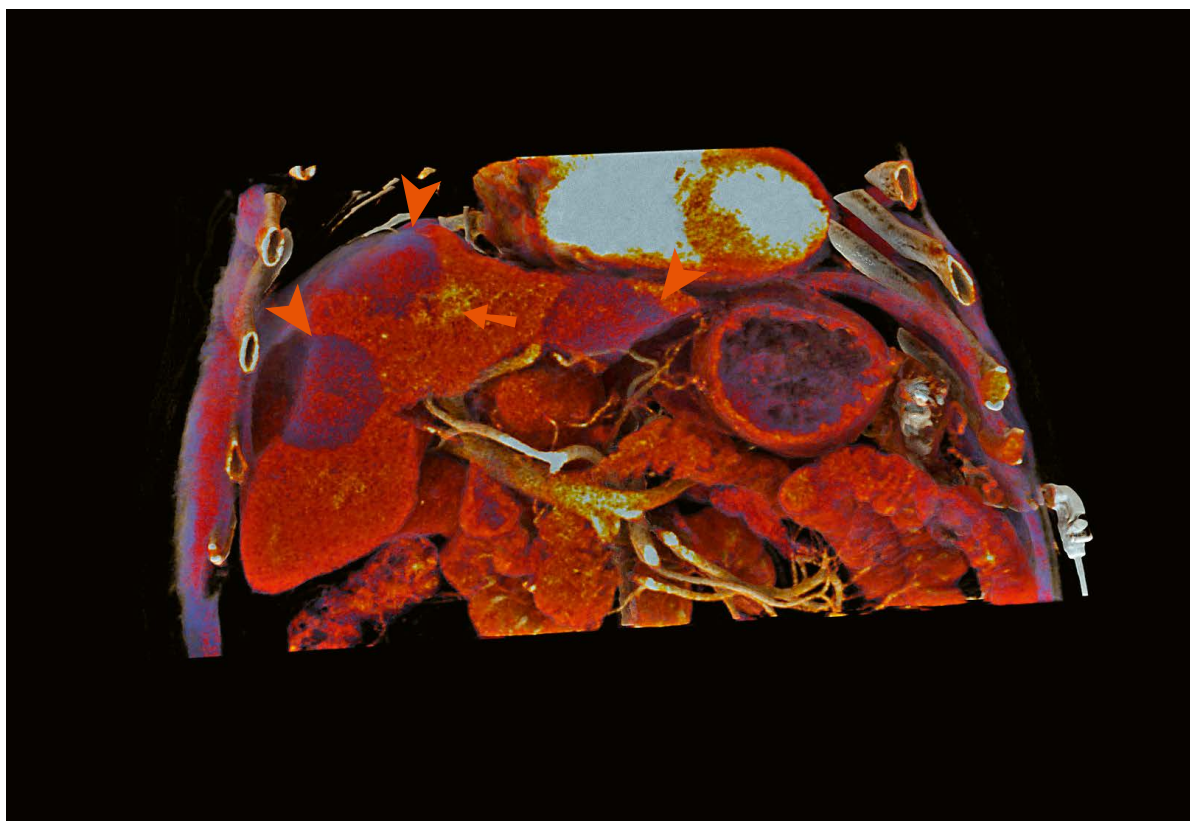
The same is true for abdominal surgery. "Especially in complex anatomical situations, these visualizations are helpful," emphasizes Christian Krautz, an abdominal surgeon at University Hospital Erlangen, Germany. In a CR evaluation study, 10 experienced senior physicians and 10 residents were to perform anatomical assessments of some difficult cases picked out retrospectively. The physicians were given CT scans, on the one hand, and CR images, on the other, and were asked, for example, to estimate whether a pancreatic tumor was in contact with the superior mesenteric artery or whether there were vascular variants in the liver. This sort of thing can be significant for the intervention strategy. Using the CR visualizations, the surgeons could

in fact answer the questions not only faster, but also more often correctly. The evaluation times for both senior physicians and residents were significantly reduced with cinematic renderings. Meanwhile, the percentage of correct evaluations rose significantly in both groups. Notably, these improvements were more pronounced in the resident group.

The ability to capture anatomical conditions quickly in 3D could also significantly facilitate communication in interdisciplinary tumor boards, adds Krautz. Moreover, the graphic visualizations may work well in providing information to patients. In a follow-up study, the Erlangen surgeons now envisage using CR prospectively in planning interventions and also to test it as an intraoperative aid to orientation. ●

#### Martin Lindner

is an award-winning science writer based in Berlin, Germany. After completing his medical studies and a doctoral thesis in the history of medicine, he went into journalism. His articles have appeared in many major German and Swiss newspapers and magazines.



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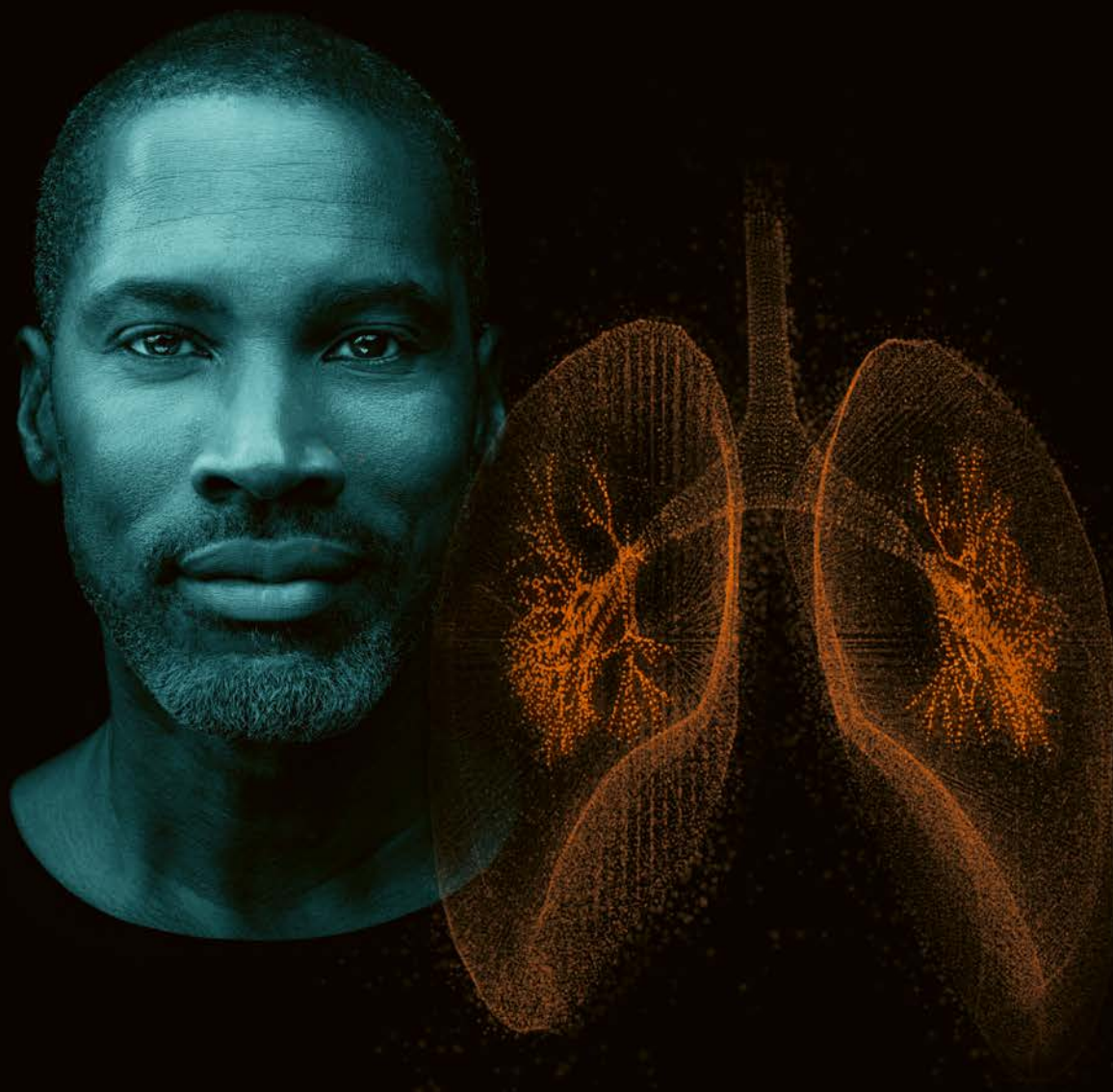
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