

**Neuroradiology**

Turning stroke care upside down with innovations in catheter therapy

**Cardiology**

Tailoring treatments to the individual patient with a digital twin of the heart

**Nuclear Medicine**

Opportunities for molecular imaging and how they are contributing to personalized care

**Radiology**

An intelligent concept for personalized, faster, and more comfortable CT scanning is here

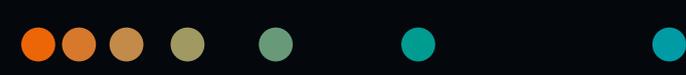
# Medical Solutions

The Magazine for Healthcare Leadership



## Innovation & Digitalization

How they relate and what it means to medicine



*“As value-based healthcare becomes increasingly prominent, manufacturers and providers will be required to act to increase patient benefits while reducing costs. Digitalization appears to be the means to achieving these previously antithetical goals.”*

**Greg Freiherr**, author of “Is Digitalization Driving Innovation or Innovation Digitalization?”, see page 6

# Innovation Powered by Digitalization: Finding New Ways to Deliver High-Value Care

Innovation is an innate human trait. We always seem to be looking for better ways to do what we do. Periodically, a new tool or idea comes along – the wheel, the printing press, generation of electricity – that jumpstarts a genuine technological revolution. Today, we're in the midst of just such a revolution, powered by digitalization.

In healthcare, digitalization and its many applications – from advanced imaging and robotics to AI and machine learning – are dramatically improving diagnosis and treatment. At Siemens Healthineers, we're tapping synergies between diagnostic imaging and advanced therapy, for example, to create advanced interventional radiology tools that enable specialists in a growing range of fields to detect and simultaneously treat serious conditions during a single, minimally invasive procedure. Insights into genomics combined with the power of AI are opening up new possibilities for precision medicine, with treatments tailored to each individual patient. By automating some parts of healthcare and at the same time allowing us to customize care with unprecedented precision, digitalization enables us to deliver healthcare more effectively, more efficiently, more conveniently, and more economically.

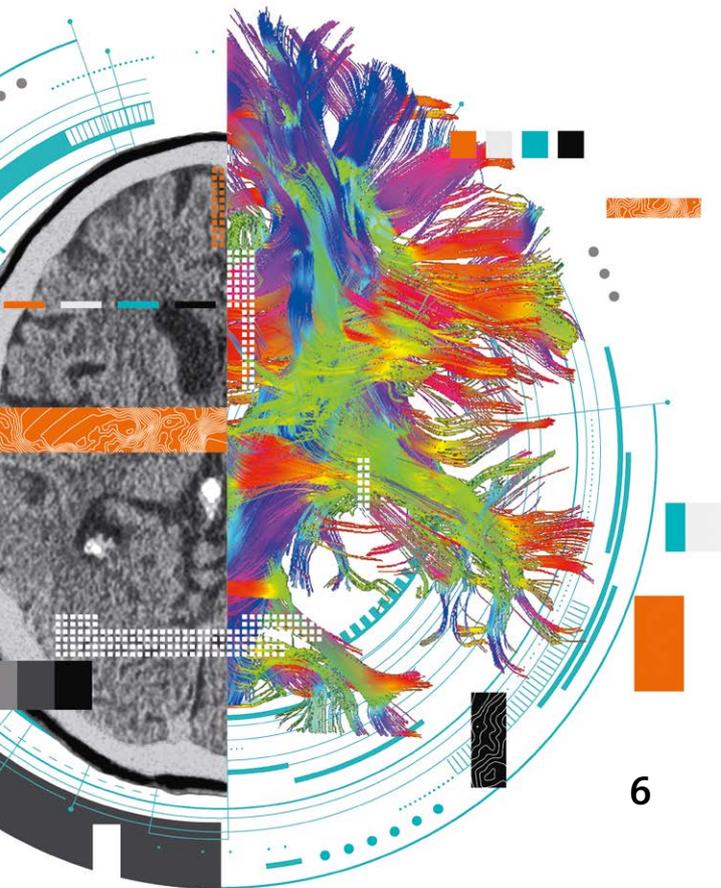
Innovators like to talk about disruption. In my view as a physician, disruptive ideas are essential to medicine, but the goal of innovation in healthcare remains what it has always been: to develop better ways to treat illness, promote wellness, and alleviate suffering.

In the following pages, you'll find plenty of examples of how some of the sharpest minds in medicine and technology are doing just that. At Siemens Healthineers, we're proud to be partners in the ongoing digital revolution that is shaping the future of healthcare.



A handwritten signature in blue ink, appearing to read 'C. Zindel'.

**Christoph Zindel, MD,**  
Member of the Managing Board  
at Siemens Healthineers



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## Innovation Culture

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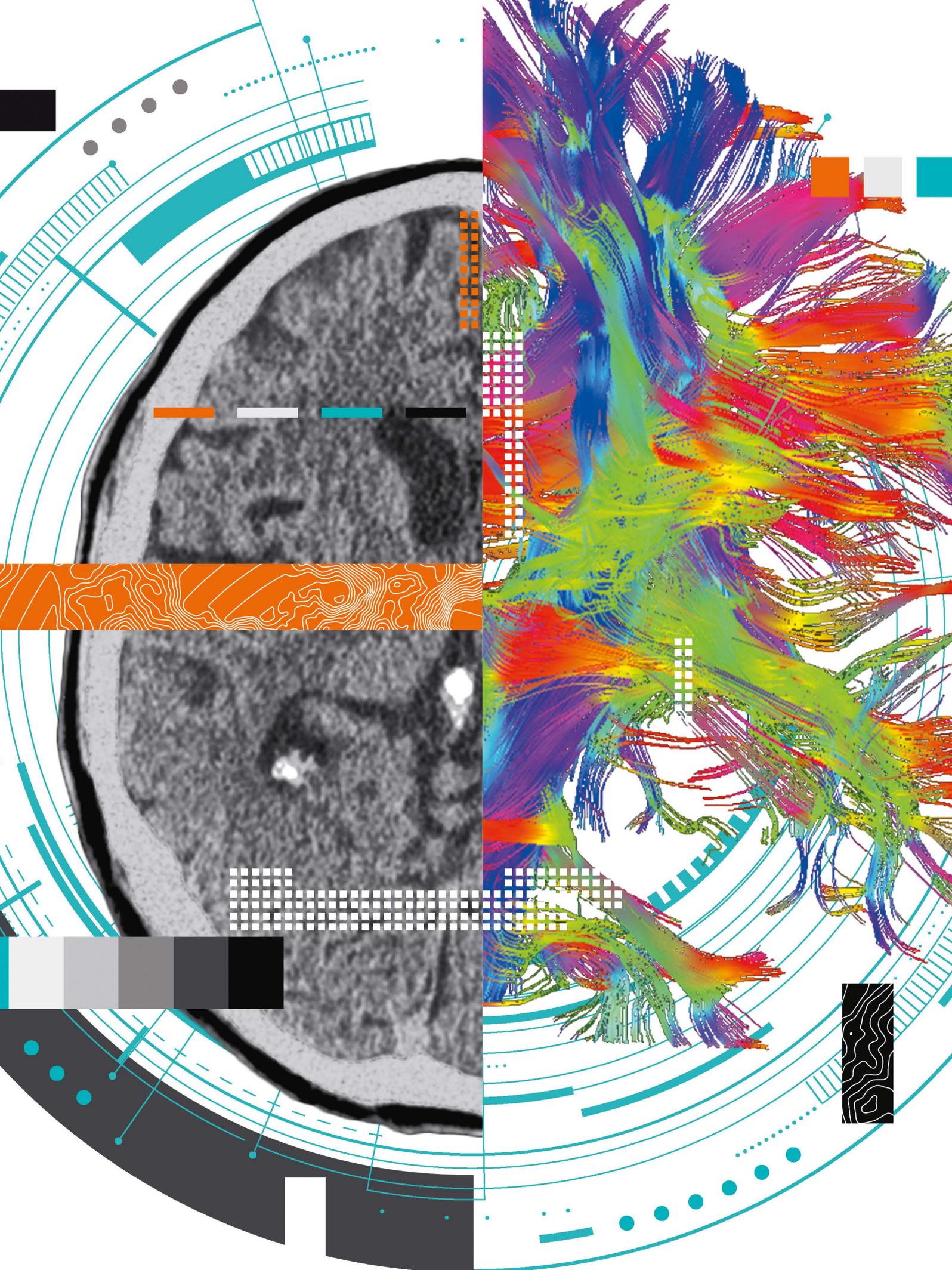
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# Is Digitalization Driving Innovation or Innovation Digitalization?

Text: Greg Freiherr | Illustrations: Dmitri Broido

**D**igitalization is a kind of Swiss Army knife. Its utility is determined by surrounding circumstances. In some instances, **digitalization** enables the development of technology; in others, it is the technology.

In medical imaging, digitalization can be like the wheel is to cars and the inclined plane is to construction. Or it can satisfy needs. This can relate to either technology or workflow – or both.

Neither MRI nor CT imaging could exist without digitalization. But determining whether

digitalization is the actual technology or rather enabled its development is a matter of perspective and, therefore, inherently arguable. Similarly, CT and MRI have markedly changed the diagnostic process.

Recently, and most obviously, workflow changes have come on the heels of technology that has automated processes, particularly automation that has increased precision. When applied at a facility or throughout an enterprise, this technology has made practices more consistent over time. The continued adoption of automation promises to increase this consistency. >

## Understanding innovation

Appreciating exactly where and how digitalization fits into healthcare requires an understanding of innovation, which may occur suddenly or incrementally. The wheel exemplifies both. Its history goes back eons.

Although the wheel itself has not changed, its application has – and so has its influence. The wheel was built into horse-drawn chariots, increasing the mobility of ancient armies; wagons that helped discover the American West; and automobiles that have changed societies around the globe.

In medical imaging, digitalization has made both sudden and incremental innovation possible. Among these are breakthroughs, such as MRI and CT imaging, as well as incremental evolutions, such as that of radiography. It continues to enable advances in digital radiography, as it

does advances in other modalities. Similarly, it makes possible the development of **artificial intelligence** (AI), which can be seen as an example of either radical or incremental innovation – depending on your perspective.

These two types of innovation – radical and incremental – are like different approaches to playing roulette. They can be as different as putting all your chips on one number or spreading those chips around. **“Organizational ambidexterity”** balances these two approaches, encouraging initiatives that exploit current technologies (as it leads to incremental innovation) and others that explore new ideas (leading to radical innovation).

### And the answer is...

But is digitalization driving innovation or vice versa? Yes...and no; either...and neither. The answer is circumstantial.

In some instances, digitalization is essential for innovation. In others it is not. Immunotherapy is one of the latter.

By leveraging the immune system, immunotherapy has helped patients with solid tumors, particularly those with melanoma and non-small cell lung cancers. RNA-based therapeutics have shown promise in conditions ranging from rare genetic diseases to cancer to neurologic illness. On the horizon is pharmacogenomic testing, which may determine the genetic makeup of patients and, thereby, pave the way to personalized medical treatment. (The data that arise from such testing, however, might be digitalized and could require digitalization for thorough interpretation.)

And, just as innovations may be designed to meet needs that are currently recognized, they may be spurred by people’s decisions to extend current guidelines. Take mechanical thrombectomy, for example: Clinical trials have shown that mechanical thrombectomy of large occlusive vessels helps patients as long as 24 hours after some occlusive strokes have occurred. In 2018, the American Heart Association and the American Stroke Association accordingly revised their guidelines on stroke treatment.

And there are instances when digitalization has been – and will likely continue to be – intertwined with progress in value-based healthcare. In some

## Glossary

### Digitalization

The conversion of data from analog into digital form or integration of computer technologies to connect and streamline systems and processes in an industry

### Artificial Intelligence (AI)

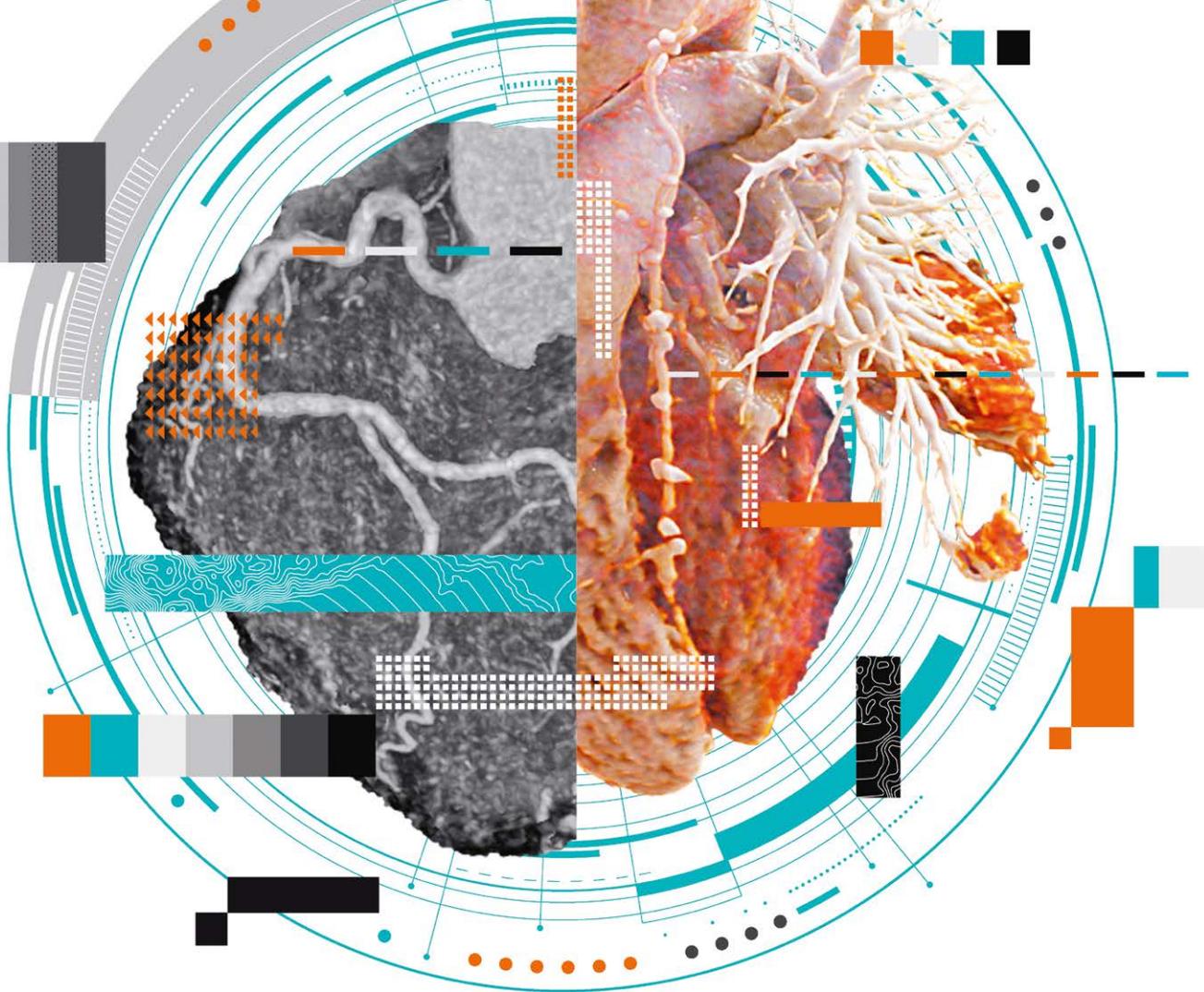
Computer-based machine learning technology that enables automation of knowledge-based decision-making to solve complex problems quickly

### Organizational Ambidexterity

The ability of a business to be efficient with its’ current assets as well as simultaneously exploring new technologies and opportunities

### Disruptive Thinking

The philosophy of innovation in industry that accepts non-conventional ideas to create market solutions and value in new ways



future cases, it will make the development of technologies possible; in others it will be the technology itself, as it has in the past. Again, digitalization is being leveraged to achieve both sudden and incremental innovation. Its use continues to have a singular purpose – to make the practice of medicine efficient and cost effective in ways that will benefit patients.

This is not because of digitalization but because of people – providers, patients, and politicians – who will call for value-based technologies. The adoption of these technologies naturally impacts work processes.

Cloud computing is already reducing the labor needed from on-site staff, for example, by making the operation, maintenance, and updating of software more efficient. Its use reduces the outlay of capital for both labor and on-site equipment, thereby potentially reducing the overall cost of healthcare. And cloud-based processes can make processes go more smoothly, helping to keep schedules on track and improving workflow.

Technologist performance might be gathered and analyzed through the cloud, resulting in efficiencies that can improve image quality, reduce radiation exposure, and further hold down costs. These results may also translate into an improved patient experience. And smart algorithms are being embedded in equipment installed on-site, for example, imaging systems, to improve such things as patient positioning.

### **The limits of digitalization**

Keep in mind, however, that digitalization is a relatively recent development. Its continued influence on innovation, therefore, is not assured. In the future, digitalization could be overshadowed by an, as yet, “unknown” kind of technology. This has happened, for example, with the development of penicillin and the age of antibiotics that followed.

While digitalization may not be required for innovation, **disruptive thinking** is. Thoughts outside the mainstream may lead to improved technologies entirely different from those



currently being used. Other disruptive thoughts – ones aimed at incremental innovation – may improve existing technologies.

Both types of thinking can impact the **continuum of care**, helping to achieve its objective: to develop speedy diagnosis and treatment. Innovation is aimed at resolving problems on this continuum.

A radical innovation, called the **Digital Twin**, for example, is being built using artificial intelligence – smart algorithms – to simulate the anatomy and physiology of individual patients. Built from patient data, such a twin might accompany its human counterpart along the continuum of care, answering difficult clinical questions without putting the patient at risk. Information obtained in real time using **the Internet of Medical Things** (IoMT) could make the Digital Twin closely resemble the flesh-and-blood patient.

Although this potential may not soon be realized, already close at hand is **clinical decision support** (CDS). Much like cruise control is to the driverless car, CDS is the expression of a near-term capability. It is “doable” with current technologies. And the information required for its operation is available.

The smart algorithms on which the Digital Twin and CDS rely is a type of AI that may involve **deep learning** (DL). These DL algorithms “learn” by diving dozens, hundreds or thousands of times into “neural networks” layered with clinical data. Through repeated experiences, they may uncover patterns that would not be apparent to people, learning for themselves how to make decisions rather than being programmed – as was typically done in the past – with rules distilled from people.

## The promise of AI

But just coming up with such rules will not be enough for AI to succeed. Its application must make a difference in the daily lives of physicians, their staff, and – most importantly – patients.

In medicine, one way to do this is to automate workflows; for example, to guide technologists in their positioning of patients. Alternatively, smart algorithms might speed up the reconstruction of images. Or they might help providers make clinical decisions.

The mechanisms underlying such improvements may be transparent, but their success on the continuum of care must be measurable. It is easy to see how this might happen. The use of AI-guided patient positioning might reduce wait times for patients; cut patient radiation dose; and improve image quality. This could lead to faster but uncompromised diagnoses, allowing patients to start treatment more quickly – and their treatments to be more personalized and precise.

Simultaneously, shorter exam times might boost productivity, leading to more patients examined per day. This could lead to higher revenues for providers. Patient experience might be improved thanks to more efficient scheduling and reduced backlogs.

As value-based healthcare becomes increasingly prominent, manufacturers and providers will be required to act to increase patient benefits while reducing costs. Digitalization appears to be the means to achieving these previously antithetical goals. But digitalization is not essential to innovation. From immunotherapy to thrombectomy, modern healthcare abounds with examples that do not involve it. But increasingly digitalization is playing an important role in innovation.

Going forward, the role of digitalization may not be as obvious as it has been. Increasingly, digitalization is blending into its surroundings. This is especially so when digitalization enables the development of other technologies, such as AI. While its presence may not be palpable, its effect likely will be.

In medicine, value is coming to mean the delivery of healthcare more efficiently, more effectively, or less expensively in ways that are safer or more comfortable for patients, plus yield better (clinical) outcomes.

And digitalization appears to be becoming more important – at least for now. ●

## Glossary

### Continuum of Care

An integrated system of care that guides and tracks patients over time, incorporating an array of health services at various levels of intensity as needed

### Digital Twin

A virtual representation of a physical asset generated by sensors, bridging the virtual and physical worlds, turning data into actionable insights

### Internet of Medical Things

Refers to the interconnectivity of medical IT systems, devices, and data through online computer networks that assist in the diagnosis, monitoring, and treatment of patients

### Clinical Decision Support (System)

Is a health information technology application designed to analyze multiple datasets to assist healthcare providers to make treatment decisions and improve patient care

### Deep Learning

Is a subset of AI that is concerned with algorithms inspired by the structure and function of the brain called artificial neural networks and that can identify multi-layer relationships that traditional machine learning algorithms may miss



**Greg Freiherr** is consulting editor to Imaging Technology News (ITN). Over the past three decades, he has served as a business and technology editor for medical publications and websites, as well as a consultant to industry, academia, and financial institutions.



# How Can Intelligent and Personalized CT Scanning Ease Radiology Workflow?

Increasingly, hospitals are aiming for more than just precision, quality, and speed in radiology. They want to go one step further – a step that the university hospitals of Erlangen and Navarra have now taken.

Text: Manuel Meyer | Photos: Stefan Hobmaier, Markel Redondo

**F**rancisco Cubo was desperate: Two years ago, the 52-year-old Spaniard was diagnosed with cancer of the kidney and malignant lung nodules. “The doctors in Madrid didn’t give me much hope,” he remembers.

The real estate broker from the Madrid suburb of Majadahonda took matters into his own hand and sought out the best possible treatment and medical care. Soon, he found the Clínica Universidad de Navarra. This clinic in Pamplona, in northern Spain, is among the country’s most prestigious hospitals and a referral hospital for the treatment of cancer and heart diseases.

Within a week, he underwent surgery. The kidney cancer was successfully dealt with. But recently, new metastases have formed in his lungs, which are now being treated and checked regularly. The journey from Madrid is a long one, but for Francisco Cubo, it’s worth the effort. “I know that here, I will be treated by the country’s top specialists with the latest technology,” he says in the waiting room of the radiological unit.

At 10:30 a.m., the computed tomography (CT) scan is performed. And by 11:20, Francisco has already received the good news: The metastases have not spread any further. The treatment in the test phase seems to be effective. “In a regular hospital, I would have waited a week for the result. That’s an eternity when you’re in fear of your life. Here, I get the result within 50 minutes. That’s priceless,” says Francisco.

## Seeking quality and personalized treatment

Such rapid diagnostics, however, require more than just quick CT scan procedures and excellent coordination between the radiology department and the treating physicians, as Gorka Bastarrika, MD, Head of Radiology, points out. “Our findings must also meet the highest possible standards of quality and precision if the doctor in charge needs them within hours in order to decide on the further treatment ahead of her consultation with the patient.”

Professional excellence combined with short waiting times and fast, personalized treatment

**Matthias May, MD,**  
Assistant Professor  
at the radiology  
department of  
University Hospital  
Erlangen and Laura  
Schwarzfaerber,  
radiology  
technologist.



Radiology nurse Begoña Sara finds that especially corpulent or less mobile patients can be positioned more easily thanks to the bigger gantry opening.

are the hallmarks of this internationally renowned university clinic. This is why patients from all over Spain and even from other European countries and Africa come to Pamplona. They are also the three reasons why banker António Assis de Almeida travels all the way from Angola to Clínica Universidad de Navarra once a year for a checkup. The clinic has many such screening patients who come for preventive examinations. However, the radiological unit is also in high demand among those seeking second opinions in cases of uncertain diagnoses. The clinic collaborates with external physicians around the globe. Results are sent out within 24 hours to anywhere in the world.

### **Complex scans – rapid and accurate**

“In order to be able to work both rapidly and with high precision, we need not just first-class personnel, but above all the latest scanning technology. That also helps us with our pioneering work in further developing the latest treatment and scanning methods,” explains Bastarrika. And that’s exactly what the patients want.

Thus, the clinic is always equipped with the latest scanner technology. Since August, Bastarrika’s radiology team has been using the new SOMATOM X.cite\* from Siemens Healthineers, which has undergone worldwide testing in five facilities and will be soon available on the market.

“Thanks to the intelligent support from the new myExam Companion as well as the automated capture of imaging and reconstruction settings, less experienced personnel can also carry out even the most complex scans quickly and accurately”, says the radiology chief. He notes that especially with cardiology patients suffering from arrhythmias, arteriosclerosis, or high heart rates, it is now much easier to standardize settings through intelligent decision trees.

This is a crucial factor for his department, since cardiac CT scans are becoming more and more frequent. “We live longer, we exercise less, and our diets are getting progressively worse. As a result, heart diseases are on the rise. At the same time, more and more physicians rely on

radiological cardiac diagnostics, which has seen massive improvement over the past few years,” explains cardiologist Juan José Gavira, MD. Accordingly, the demand for cardiac CT imaging is rising, too.

### **A new era in computed tomography**

But what are the concrete advantages of the new CT scanner for the patient? “The examination is faster and more comfortable, and the new system generates a quicker reconstruction, which means that the patients get their results sooner,” says Bastarrika. He also points out that the scanner’s automated voice commands for patients are available in many languages, which is ideal for the Clínica Universidad de Navarra and its many international patients.

Another example is the bigger gantry opening: Larger and less mobile patients in particular, or those attached to medical devices can be positioned more easily, says radiology nurse Begoña Sara. “It’s much more comfortable. You no longer feel like you’re imprisoned,” agrees cancer patient Francisco Cubo. For him, however the biggest advantage is this: He wears a hearing aid, which he had to remove before each scan, making it difficult to understand the breathing instructions. “The new visual color codes indicate when you must breathe in or hold your breath, makes it much easier for me,” he explains.

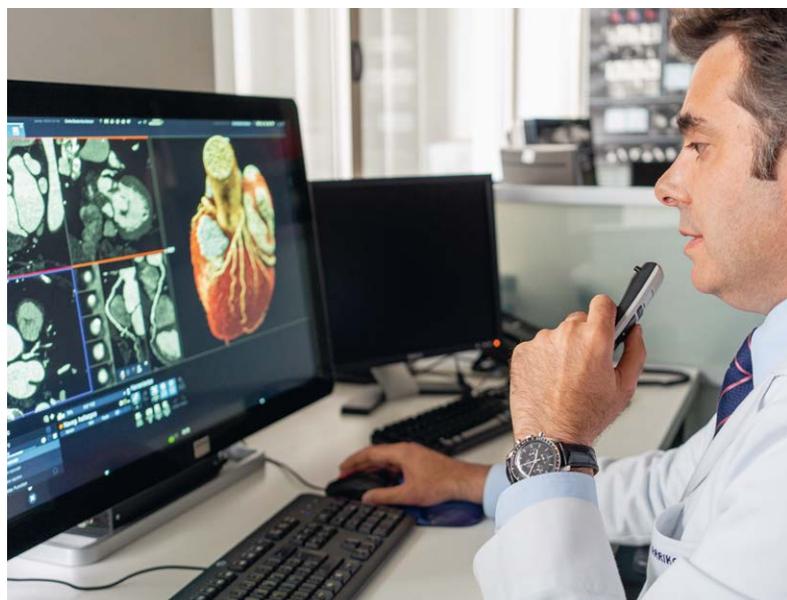
“We are a clinic that emphasizes the personalized treatment of our patients. That’s also what our patients expect. Thus, SOMATOM X.cite is perfect for us. It’s not just one of the most versatile devices on the market, but it is also the first to facilitate personalized, individualized scanning. This marks an improvement for the doctors, for staff, and for the patient. As far as I’m concerned, this machine marks the beginning of a new era in computed tomography,” says Bastarrika.

### **Human-centric focus**

Matthias May, MD, Assistant Professor at the radiology department of University Hospital Erlangen, Germany, which also took part in the SOMATOM X.cite pilot study, agrees: “The scanner

*“Our findings must also meet the highest possible standards of quality and precision if the doctor in charge needs them within hours in order to decide on the further treatment ahead of her consultation with the patient.”*

**Gorka Bastarrika, MD**, Head of Radiology, Clínica Universidad de Navarra



For Gorka Bastarrika, MD, Head of Radiology, Clínica Universidad de Navarra, the new scanner marks a new era in computed tomography.

Laura Schwarzfaerber and Matthias May, MD, appreciate the patient-centric workflow the new system allows.



*“Many of my colleagues spend most of their working hours operating MRI scanners or X-ray machines, and they often feel out of their depth when working with the CT scanner. But with this user concept, nearly all of them find it easy to switch to CT.”*

Laura Schwarzfaerber, radiology technologist, University Hospital Erlangen, Germany

is definitely the first step toward personalized radiology.” Thus, he had no reservations about taking part in the current test phase. For years, he has been working closely with Siemens Healthineers on the development of the latest scan protocols and procedures at the Imaging Science Institute.

“As a university hospital, we have a clear mandate for training and research in addition to medical care, which we can only fulfill if we also have the latest technologies at our disposal.” In order to research new treatments or to introduce the next generation of radiologists to future technologies, May explains, it is necessary to have state-of-the-art in technology. Moreover, he notes that University Hospital Erlangen is a specialized facility. “We also need the latest technology in order to be able to treat cases that exceed the capabilities of regular communal hospitals.”

The SOMATOM X.cite is a “good all-rounder”, says May, incorporating the technical innovations of the past decade. However, as he explains, scanning time and image quality are no longer the main issues in radiology today. Rather, the goal is now to make scanning easier, thus making the experience more pleasant for patients, while relieving staff members from additional tasks and allowing them to use more of their time to spend with the patient. After all, he notes, the focus here is on individuals who are worried about their health.

“And where can we save time or relieve the burden on staff? On the periphery, when it comes to preparing the patient, the scan, or the reconstruction,” says May. It is here that the new intelligent user concept myExam Companion really comes into play. Currently, the companion guides users with up to 20 default decision trees.

## Good guidance for all experience levels

“By using these predefined decision-making criteria, and assisted by automated capture and reconstruction settings, even less experienced staff are able to scan rapidly and flawlessly with the optimal image quality, X-ray dose, and contrast medium dose,” says the radiologist. This, he believes, is the upcoming trend in CT imaging. “We envision a future where you won’t need to be an expert to operate a CT scanner. This will be crucial not only in regions lacking a radiologist, but even here in our hospital: For instance, if less experienced personnel find themselves in stressful emergency situations or alone during their night shift.”

On the other hand, this very aspect is also of particular importance for a German university hospital with a training mandate as affects not only students, interns from other hospitals, or staff in training. “Many of my colleagues spend most of their working hours operating MRI scanners or X-ray machines, and they often feel out of their depth when working with the CT scanner. But with this user concept, nearly all of them find it easy to switch to CT imaging,” says Laura Schwarzfaerber, who works as a radiology technologist in Erlangen. She believes that the system is highly intuitive, self-explanatory, and easy to learn. Users are no longer required to familiarize themselves with as many technical details. “Really, all you need to do is answer a series of questions, and then – based on your responses – click through the system, which will pick the appropriate scanning protocol,” Schwarzfaerber explains.

Whereas a thorax CT scan used to require up to seven different protocols, she now only needs to select one. The scanning process is not only personalized for each patient, but is even tailored to their specific requirements. On the tablet, Schwarzfaerber clicks through the decision tree for the thoracoabdominal CT scan. Should the scan be restricted to the epigastric region or the abdomen? Is the patient able to hold his or her breath for more than 12 seconds, or not? Does the patient have any metal implants? Should the scan be done with dual or single energy?

## Huge time savings in positioning

Automated algorithms read the patient’s ECG and feed it directly into the user system, which calculates the appropriate protocols and doses

of radiation adjusted for ECG data, weight, size, and age. Schwarzfaerber, holding her tablet, stands beside the patient, who is already lying on the scanner table. The fully automated positioning program, supported by a 3D camera, places the patient in the optimal position. “We save loads of time at this stage, since all of these steps had to be done manually before,” says Schwarzfaerber.

With the advanced tablet functionalities, she can now remain at the patient’s side even longer – “and that makes them much more calm and relaxed, which also assists our scanning process.” For the scan itself, Schwarzfaerber returns to the control room. With the scanner’s 2D camera, she can continue to monitor the patient carefully. “Looking at his face, I can see immediately whether he is uncomfortable, in pain, or nervous, and can react quickly.”

While one radiology technologist is already busy with automated reconstruction and archiving in the diagnostic room, another can get to work in the treatment room with the tablet, position the next patient, and prepare the scan. “The mobile environment means that work processes can be carried out in parallel, more flexibly, and with optimal use of time,” says May, the senior physician.

The time savings also benefit the university hospital as a whole: As a referral and specialist hospital for a catchment area including about one million potential patients, it has a considerable scanning workload of 40 CT scans per day. “Now, consider that we are also a training hospital. This means that we senior physicians always have to re-check the findings of our younger colleagues and doctors in training before they are passed on to the attending specialist.” This additional expenditure of time can be compensated for, according to May, as the work processes are accelerated. ●

**Manuel Meyer** is an independent journalist. He reports for Deutsche Ärztezeitung and other media from Madrid, Spain.

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.

\*SOMATOM X.cite with myExam Companion is pending 510(k) clearance, and is not yet commercially available in the United States. Some products and features are not commercially available in all countries. Due to regulatory reasons, their future availability cannot be guaranteed. Please contact your local Siemens Healthineers organization for more details.



Radiologist Ralf Bauer believes that innovative digital technologies are important tools to assist doctors in providing quality patient care.

# Artificial Intelligence Leads to Greater Confidence in Diagnostic Imaging

## High-end devices in outpatient care? For Professor Ralf Bauer, a partner at RNS Gemeinschaftspraxis in Wiesbaden, high diagnostic quality is an essential precondition for any application in radiology, including the use of artificial intelligence.

Text: Hildegard Kaulen | Photos: Carsten Büll

**T**he radiologist Professor Ralf Bauer knows what he wants. Having consciously decided to leave his hospital career behind him, he has now become a partner in a joint practice. "Being a doctor is a liberal profession," he says. "I want to take advantage of that freedom so that my partners and I can make strategic decisions that we not only believe are prudent and correct, but that also allow us to provide maximum diagnostic quality for referring physicians and patients alike while remaining business-focused – which is of course essential." The radiologist studied medicine in Frankfurt am Main before qualifying as a university lecturer at the city's university hospital, where he also served as an attending radiologist. After a stint at the Cantonal Hospital St. Gallen, he has been one of four partners at RNS Gemeinschaftspraxis in Wiesbaden since July 2018. The joint practice maintains five centers in the Rhine-Main area, two of which are located in hospitals.

### **Focusing on the heart**

Bauer and his partners perform the full range of examinations arising from private practice or through their close links with hospitals. Besides his diagnostic focus on cardio-thoracic, liver, and

vascular imaging, as an interventional radiologist himself, he also regularly performs procedures. A few months ago, St. Josefs-Hospital Wiesbaden acquired a SOMATOM Force Dual Source CT scanner, which is equipped with two radiation tubes and two detector systems. "We chose this amazing high-end device because we consciously want to further expand our cardiac imaging," says Bauer, who has been working with Dual Source technology for twelve years. "For me, SOMATOM Force is the best cardiac scanner on the market today."

The physicians who refer patients to him for a heart scan are typically cardiologists seeking answers to very specific questions. Can coronary heart disease be ruled out in a patient with unusual ECG readings or nonspecific chest pain? What state are the patient's bypasses in? How permeable is the stent? "With the cardiac CT scanner, we can answer these questions in ten minutes," says Bauer. "That's all it takes to examine the status of the coronary vessels in high diagnostic quality and without the risks associated with cardiac catheterization. On average, the resulting radiation dose is no higher than a quarter of the annual background radiation in Germany." Moreover, Bauer is noticing a change in people's preferences: "Many patients would

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*“AI applications will allow us to diagnose patients faster, more consistently, and with fewer errors, so we stand to gain not only time but also confidence...”*

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RNS Gemeinschafts-praxis acquired a SOMATOM Dual Source CT scanner to expand their cardiac imaging.



rather be examined with the CT scanner than with a cardiac catheter. Some patients absolutely dread cardiac catheterization – and cardiologists are sensitive to that.”

### **Equipped for artificial intelligence**

With a SOMATOM Force, Bauer and his partners are also ready for the arrival of artificial intelligence (AI) in radiology. “To some extent, AI applications disconnect the diagnostic process from the operator’s experience,” says Bauer. “I therefore expect that they’ll make diagnoses more consistent, even in the face of considerable time pressure and a heavy workload – after all, we’re now having to examine more and more patients in an ever-shorter time. This cannot be allowed to affect the quality of the results, regardless of the complexity of the examination.”

Radiology will benefit primarily from “deep learning” applications, in which algorithms are trained to recognize structures better and better over time. So-called computer-aided diagnosis (CAD) systems work in a similar way, although future AI applications will take these pattern recognition techniques to the next level. Will AI therefore threaten the role of radiologists? Bauer isn’t in the least bit concerned. “Algorithms don’t know what we don’t know,” he says. “They can’t recognize meaning. They simply see what we’ve trained them to see, although they are extremely good at it. We’ll still be responsible for making the diagnosis and for discussing it with the patients. I don’t buy into the idea that we’ll soon have an instrument that scans patients and simply reads the findings out to them,” Bauer adds. “When it comes to issues as important as sickness and health, which touch upon our most primordial fears, there’ll always be a need for doctors. Ultimately, that’s also my understanding of personalized medicine – consistent patient orientation in everything we do.”

### **Greater confidence thanks to artificial intelligence**

That being said, this is another area where Bauer believes AI applications will be of assistance. “AI applications will allow us to diagnose patients faster, more consistently, and with fewer errors, so we stand to gain not only time but also confidence – confidence in the robustness of the

Ralf Bauer expects that AI and “deep learning” applications will create more consistency in diagnosis.



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*“When it comes to issues as important as sickness and health, which touch upon our most primordial fears, there’ll always be a need for doctors.”*

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diagnosis and time to talk to the patient. No one leaves our practice without receiving a detailed explanation of the findings.”

Time and confidence in the robustness of the diagnosis are also essential in terms of the radiologist’s growing influence on disease management, which goes well beyond simply detecting pathological changes. “Of course, we also participate in the tumor boards at the hospital locations – as highly specialized advisers on an equal footing with other clinical partners,” says Bauer. “We’ll have even more to offer in this role if we can use AI applications to gather more information from the scans with regard to therapeutic planning or the prognosis.” Thanks to the excellent quality of the scans, Bauer and his partners are also in a position to participate in the development

of new algorithms. RNS Gemeinschaftspraxis is currently one of only two centers in the world that are testing a new ultra-high resolution scan mode for chest CT imaging for the detection of small nodules and very early signs of fibrosis in the lungs. This would not have been possible without a high-end device. ●

**Hildegard Kaulen, PhD**, is a molecular biologist. Following positions at Rockefeller University in New York and Massachusetts General Hospital in Boston, she has worked as a freelance science journalist for respected daily newspapers and scientific magazines since the mid-1990s.

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.



## Making All the Difference: High-Quality CT Scans Directly in the ICU

Intensive care patients with head injuries depend on fast, reliable imaging results. The conventional way involves transporting patients from the ICU to the radiology department. Imaging with mobile head CT scanners directly at the patient's bedside reverses the process and simplifies the workflow, reduces risky transportations, and can help lower costs – while maintaining high-quality images.

Text: Matthias Manych



**A mobile CT head scanner\* can be brought directly to critical patients, eliminating the need for risky transportation.**

**A** patient lies in the intensive care unit (ICU) and is prepared for a CT scan of the head. The man was involved in a bicycle accident, in which he sustained multiple injuries and a severe traumatic brain injury (TBI). Now the physicians want to know whether bleeding has occurred in the space between the cranial bone and the dura mater, as is often the case with TBI.

Computed tomography (CT) is most commonly used to assess patients with brain injuries in the ICU. Around 40 percent of all CT examinations involve the head area. CT imaging provides fast and reliable information on the exact location and extent of bleeding, edema, and other brain injuries.

### **Patient transport: a burden on staff, budget and patients**

At present, the critically ill and only partially cooperative patients need to be prepared for transport to the radiology department. This is always a logistical and personnel challenge since the supply of and monitoring with cardiovascular monitoring technology, ventilation, syringe pumps, and infusion pumps must be guaranteed during transport. Hygienic requirements are also higher.

While two employees prepare the transport, up to five accompany it with all the medical equipment. Colleagues in the radiology department prepare the examination room.[1]

The patient is then carefully transferred to the CT table and CT technologists take care of the scan. The personnel-intensive process from transport to completion of the CT examination takes an average of 50 minutes.[1]

At the same time, the procedure involves considerable risks for the patient. One third of all transports can result in mishaps.[2] For example, the connection to the monitoring equipment or to the medication supply could be interrupted, and even the ventilation access could be inadvertently removed. Transport to the CT scanner is particularly susceptible to risk: 71 percent of all transport incidents occur in such cases.[2]

### **Head imaging at the point of care**

How would the situation change if the processes were reversed? If it weren't the patient who was brought to the CT scanner, but rather the scanner to the patient? A mobile head CT scanner has the potential to provide the diagnostic performance and speed of this imaging technique directly at

the point of care. Patient and staff no longer need to leave the ICU for transportation to the radiology department. The patient remains constantly connected to monitoring and medication supply at his or her bedside during the CT scan. In the event of complications, the entire spectrum of intensive care therapies is immediately available. In addition, a mobile head CT scanner can be used even if the patient's condition excludes transport. Fellow patients also benefit from imaging directly at the point of care, because clinical staff who might have been involved in the transport can now stay close to the patients and solve acute problems immediately.

High-quality CT imaging should be possible for all patients, whether or not they are able to cooperate and be transported. A mobile head CT scanner must be suitable for the busy and tight ICU environment. In order for such a system to significantly relieve the burden on patients

and staff, it must be easy to maneuver and operate, while at the same time offering intelligent solutions for patient positioning and radiation protection. Siemens Healthineers has combined these features in an innovative mobile head CT scanner, which is currently under development.

### Reducing pressure

The use of mobile head CT technology measurably reduces the workload of ICU staff: instead of 50 minutes, imaging may take just 18 minutes with a mobile device.[1] Work such as reconnecting the patient to the monitoring and supply equipment and disinfecting the ICU room after returning from the imaging department is no longer necessary. Because the entire staff is available at least during the day for the tasks arising in the ICU, the workload is distributed. Currently, when ICU patients have emergencies during the night shift that require a head CT examination, the situation becomes very challenging for non-senior staff, especially if they do not have access to expert knowledge. This situation could be mitigated by performing CT imaging directly on the wards.

Head imaging directly in the ICU has a similarly positive effect for the imaging department. It can help avoid schedule interruptions in the radiology department that can occur when critical patients need to be scanned. As a result, scanner capacities can be planned more efficiently. While the examination of an intensive care patient with a conventional CT scanner involves up to two CT technologists, only one specialist is required for the mobile modality. By reversing the head CT imaging process, risky transportation of critically ill patients can be avoided, while more capacity is created for the hospital and its staff. ●

**Matthias Manych**, a biologist, works as a freelance scientific journalist, editor, and author specializing in medicine. His texts appear primarily in specialized journals, but also in newspapers and online.

\*SOMATOM On.site is currently under development. It is not available for sale in the United States. Its future availability cannot be guaranteed.

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*"The transportation of critical or unstable patients is really risky and stressful for both the patient and the nursing staff. When we have a mobile CT scanner in the neuro intensive care, we hope to improve the care of our patients by skipping the risky transportation and scanning them directly on our ward."*

**Nils Ståhl**, Neurosurgery,  
Skåne University Hospital Lund





*“A mobile CT head scanner for the ICU would ease the scheduling of our scanner in the radiology department, because we would no longer have to interrupt our regular schedule for critically ill patients.”*

Roger Siemund, Neuroradiology, Skåne University Hospital Lund



The mobile CT head scanner\* is easy to maneuver and operate in an ICU setting, eliminating the need for patient transport.

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# Stroke Thrombectomy: Implementing Life-Saving Neurointerventions

Advancements in catheter therapy have in recent years turned stroke care upside down. Interventional specialists can often save patients with even the most severe strokes – provided the patients arrive at the hospital on time. All over the world, interventional radiologists are busy making sure that all patients who might benefit from catheter therapy get access to it. But there is still some way to go.

Text: Philipp Grätzel von Grätz | Photos: Bernd Schumacher

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Christian Loewe, MD, Head of the Department of Cardiovascular and Interventional Radiology (left) and Florian Wolf, MD, Deputy Head of Interventional Radiology at Medical University of Vienna.

**O**rganizing stroke care effectively is a task that many hospitals and regions have to address. Traditionally, patients with a suspected stroke were brought to hospitals with a stroke unit where they were diagnosed and, if possible, received IV thrombolysis as quickly as possible. Today, things are more complex: Modern catheter therapy allows doctors to remove the clot that blocks the brain artery in ischemic stroke mechanically, typically using a device called a stent retriever.

In cases that are suitable for this type of therapy – patients with severe strokes in large vessels

*“There are patients who can go back to work just weeks after a major stroke. This didn’t happen five years ago. I can hardly think of another innovation in recent years that has transformed the delivery of care so profoundly for the better.”*

**Christian Loewe, MD**, Head of the Department of Cardiovascular and Interventional Radiology at Medical University of Vienna

of the brain – the clinical results are often impressive, says Christian Loewe, MD, Head of the Department of Cardiovascular and Interventional Radiology at Medical University of Vienna (MUV): “There are patients who can go back to work just weeks after a major stroke. This didn’t happen five years ago. We often receive thank-you letters. I can hardly think of a other innovation in recent years that has transformed the delivery of care so profoundly for the better.”

### **Key to early therapy: collaboration, tools, access**

Stroke thrombectomy is highly effective, but it isn’t easy to implement: “We’ve moved away from very strict time windows. But the basic message for stroke care still holds: ‘time is brain’. We have to diagnose and treat as quickly as possible,” says Loewe. In order to make this happen, all relevant disciplines have to collaborate closely, according to Florian Wolf, MD, Deputy Head of Interventional Radiology at MUV: “This didn’t work particularly well at MUV in the beginning. But over time, we have managed to decrease door-to-needle time considerably.”



Speed is one factor that is critical for best possible stroke therapy. Proper equipment is another. The interventional radiology department at Medical University of Vienna has recently acquired an ARTIS icono biplane angiography system from Siemens Healthineers. For Wolf, treating stroke patients with the new system is a huge step toward expanding precision medicine: “With two planes, stroke thrombectomy is safer, better, quicker. The risk of complications is lower, because the blood vessel anatomy is much clearer. In the past, we had to park the C-arm of the second plane to acquire 3D volumes. This is cumbersome, so we often did without it. Now we acquire 3Ds with two planes effortlessly. Neuro-interventions are far more precise.”

The number of catheter interventions in stroke cases is rising worldwide. But there are still many patients with ischemic stroke who are candidates for a thrombectomy but don't receive one: “In Vienna, we estimate that only one third of patients who would benefit from a stroke thrombectomy actually gets one,” says Loewe. There are several reasons for this: Preclinical and early clinical stroke care hasn't adapted properly to the new realities in many places. Awareness

campaigns notwithstanding, strokes are too often still diagnosed too late. Another problem in many countries is that there aren't enough hospitals that offer neurointerventions in stroke cases.

### **Biplane angiography beyond stroke**

From a hospital perspective, an important question is how to make the most of investments when beginning to offer stroke thrombectomy with a modern angiography system: “Even for a university hospital like ours, it's not possible to use a system to full capacity with stroke patients alone,” says Loewe. One solution is to use the

*“Angiography systems like this one offer the possibility to perform the necessary brain imaging in stroke patients right in the therapeutic setting. We can diagnose the patient and perform the intervention using the same system.”*

**Florian Wolf, MD**, Deputy Head of Interventional Radiology at Medical University of Vienna





system for other neurointerventions, in particular for coiling aneurysms. The interventional radiologists at Medical University of Vienna don't do this, however. Instead, they take a different approach: In addition to stroke thrombectomy, they perform body interventions.

"For liver embolization or prostate embolization, for example, the new biplane system is a big advantage," says Wolf. "The second plane is also great for high-flow vascular malformations that require liquid embolic agents." Even supposedly simple interventions – like placing a PEG tube – become more precise and comfortable with two

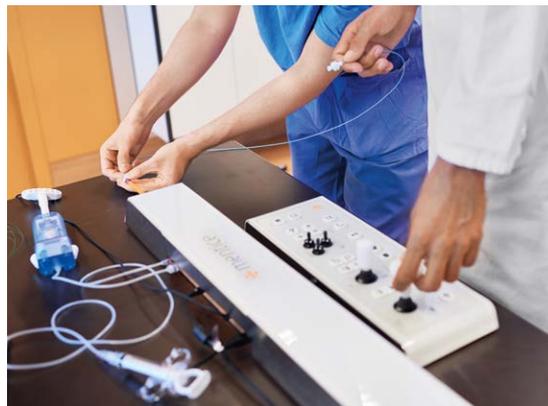
planes. Wolf also explains the value for complex interventions: "I recently used it for a TIPS, and again it was very helpful. I took a quick look at the two planes and knew exactly where to place the shunt. By using the new biplane system for these and many other procedures besides thrombectomies, we manage to achieve full utilization."

### **Experts needed. Can simulators help?**

A bottleneck for the required expansion of interventional stroke therapy could well be the number of physicians able to perform it. For comprehensive coverage, many more experts will



A big step toward expanding precision medicine: the ARTIS icono biplane angiography system that is used to treat stroke patients in Vienna.



Left: The Mentice simulator can be connected to the ARTIS icono display and controls, allowing doctors to practice on real angiography tables.

be needed than are currently available. One way of scaling up thrombectomy training is to use modern simulators." Today, thrombectomy training is still largely 'learning by doing' during real interventions," says Wolf. "But I am absolutely convinced that simulators are the future. A few years from now, every thrombectomy specialist will have practiced using simulators."

The interventional radiology department at Medical University of Vienna is currently in the process of purchasing a Mentice simulator. It can be connected directly to the display and tableside controls of the ARTIS icono: "This will allow our

young colleagues to practice on real angiography tables and with real monitors, making the simulation even more realistic," says Loewe. But real patients will always come first, of course. ●

**Philipp Grätzel von Grätz** is a medical doctor turned freelance writer. Based in Berlin, Germany, his focus is on biomedicine, medical technology, health IT, and health policy.

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# The Evolving Role of Interventional Radiology

From its beginnings in the 1960s, interventional radiology (IR) has evolved and expanded rapidly, driven by technological and medical advances that have improved outcomes and increased the range of applications.[1,2] Today, across a growing spectrum of disciplines – including cardiology, radiology, neuroradiology, and oncology – more and more procedures are being performed in the IR suite. Image-guided, minimally invasive therapies are growing at a remarkable rate of 10.5 percent annually.[3]

Text: Peter Jaret | Illustration: Ilona Burgarth

## Designing the interventional suite of the future

**A**s the range of applications has expanded, interventional radiology (IR) procedures have become more complex. The number of older, comorbid patients who can be treated with IR has also increased. These trends are driving another fundamental shift: After decades of being focused on procedural expertise, IR is expanding to include more comprehensive patient care both before and after interventional treatments.[1,2]

The evolving role of IR presents both enormous opportunities and pressing challenges to institutions looking to position themselves to meet future demand and remain competitive. One of the biggest challenges is designing IR suites with the capacity to meet today's needs and accommodate the demands of tomorrow. Experts point to five attributes that will be critical to success.

### 1. Efficiency

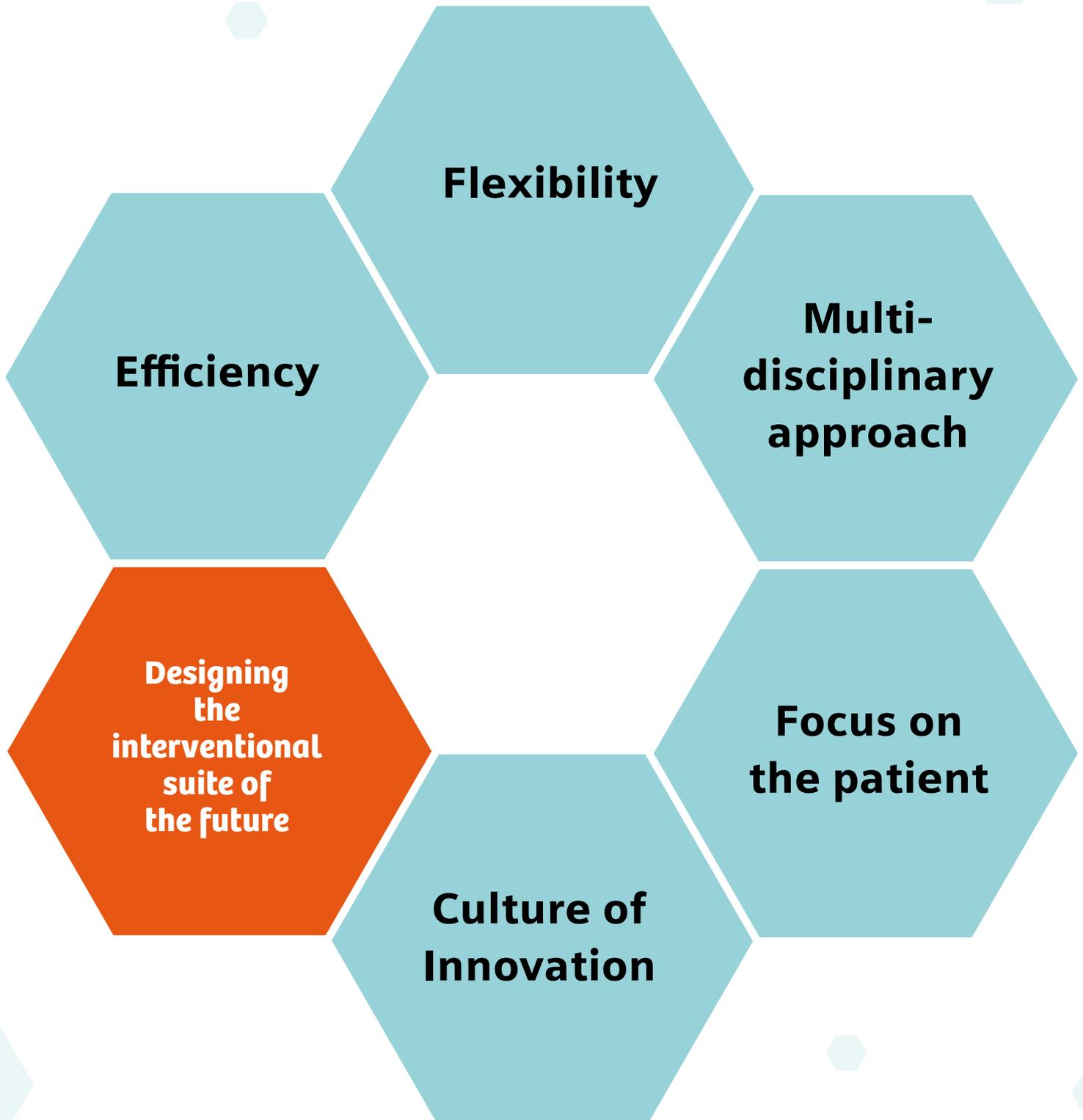
With more and more treatments migrating to IR, the ability to diagnose and treat patients efficiently will become increasingly critical. High patient volume is important to the bottom line, of course: Organizations that are able to expand minimally invasive, image-guided treatments can increase

referrals and reduce costs associated with hospital stays and high-dependency care. Efficiency is also key to better outcomes. In the case of thrombectomies, for example – one type of neurological procedure being done with IR – quick diagnosis and treatment is essential to preserving brain tissue.

Thanks to improved imaging, many patients with suspected stroke can be diagnosed and treated in the IR suite, reducing time-to-thrombectomy by 34 minutes on average by using the angio-only approach.[4] Across the full range of IR procedures, standardized case flows – dedicated sequences of system settings for each diagnostic and interventional step – will play a growing role in streamlining IR procedures and ensuring consistent outcomes. These powerful tools have the potential to transform the way care is delivered. Customized case flows can be shared with other colleagues, supporting best practices, ensuring more consistent outcomes and documentation, and reducing training time for new staff.

### 2. Flexibility

Flexibility will become even more important in the future as procedures from across a range of disciplines transition to the IR suite. Advanced imaging tools are being designed to accommodate a wide range of procedures and practitioners





**As the role of radiology expands from diagnostics to treatment across disciplines – the IR suite design will be patient-centric and flexible.**

seamlessly, bringing all the information physicians need from imaging studies to medical histories together in user-friendly formats. The same standardized workflows that ensure consistent results must also be designed to be flexible enough to be adapted to individual patients and physician preferences. The IR suite of the future will utilize flexible, context-based case flows that allow physicians to create and save their own personal preferences.

### 3. A multidisciplinary approach

The angio lab of the past is fast becoming a multidisciplinary interventional suite where cardiologists, interventional radiologists, neuroradiologists, oncologists, and other specialists perform a growing number of procedures. In addition to cardiovascular and vascular interventions, for example, IR is increasingly being used to perform percutaneous thermal ablation of tumors (such as renal cell and hepatocellular carcinomas) and percutaneous sclerotherapy for low-flow venous and lymphatic malformations of the head and neck. New applications of IR are certain to follow. That means the IR suite of tomorrow will increasingly need to accommodate the requirements of very different specialists. Imaging and interventional tools must be designed to adapt rapidly to the positioning needs of both cardiologists and neuroradiologists, so that both disciplines can share the lab without any compromises. From a business perspective, a broader procedure mix will improve utilization of interventional tools and amortize costs more rapidly. But making minimally invasive IR procedures available across disciplines also means that patient outcomes are likely to improve.

### 4. Focus on the patient

Patient satisfaction will become increasingly crucial to competitive success and better outcomes. Many of the technological advances that are improving procedural efficiency also impact the patient experience. More efficient workflows, for example – including “one stop” diagnosis and interventional treatment – mean that patients can be diagnosed and treated much more rapidly, minimizing stress and discomfort. Imaging equipment designed to adjust and accommodate a wide range of patients comfortably will also improve the patient experience. As IR is used increasingly for complex treatments of patients with multiple comorbidities, the IR suite of the future will also need to be designed

to support comprehensive clinical care, from preprocedural workups to follow-up care and ongoing engagement with patients. It will increasingly be seen as one part of a continuum of care on a patient’s journey.

### 5. A culture of innovation

Technological and medical advances will continue to transform IR. The introduction of robotic vascular inventions, for example, will give physicians even more precise control to guide catheters, guidewires, balloons, or stent implants via integrated imaging. Robotic control also allows physicians to control procedures remotely, reducing their exposure to radiation. Interventional radiologists, perhaps more than any other specialists, understand the critical importance of advanced technologies like these, wisely used. An IR culture that is committed to evaluating and incorporating the latest advances will be positioned to continuously improve patient outcomes, reduce waste and errors, improve efficiency, expand the scope of its services, maintain top morale, as well as attract and retain the best staff.

### Preparing for tomorrow

No one can predict the future. But if there’s one lesson from the past, it’s that technological innovation and medical advances will open up new opportunities for diagnosing and treating a growing range of conditions using the tools of interventional radiology. By positioning themselves at the leading edge of innovation, institutions can design IR suites flexible enough to meet the demands of the future – improving efficiency, boosting productivity, and ensuring the best patient care. ●

**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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# Multidisciplinary Equipment Usage Bolsters French Private Hospital's Bottom Line

As a private hospital, Clinique Clairval needs to keep a keen eye on their bottom line. By sharing operating theaters and equipment, cardiologists and neuroradiologists are helping their institution to get a quicker return on investment.

Text: Matthew Lenson | Photos: Matthieu Colin

**S**erving France's second largest city, Marseille, on the Mediterranean coast, the 385-bed Clinique Clairval overhauled its interventional units to allow two of its flagship specialties, cardiology and interventional neuroradiology, to work side-by-side. This move coincided with the purchase of two angiography systems, a biplane and single plane. And it led to an unprecedented collaboration between the two disciplines.

The biplane system is an "indispensable tool for endovascular cerebral interventions," according to Olivier Levrier, the neuroradiologist who conceived the scheme and sold it to the business side. "All neuroradiologists in interventional neuroradiology or endovascular neurosurgery everywhere have biplanes," he says. "It's the most appropriate tool. If we didn't use it, we'd see poorer results. That's not the case for cardiology."

At Clinique Clairval, the monoplane system is run by cardiology alone, but by sharing the better-equipped biplane installation, essential for interventional neuroradiology, the hospital can provide top quality across the board while making a quicker return on its investment. This opens up the possibility of more frequent equipment updates, meaning that the institution can always offer its patients the best available technology. At the same time, various positive side effects have been observed, such as increased collaboration across disciplines and improvements in staff skills as well as greater satisfaction as employees learn about other kinds of interventions. The biplane system also helps stroke patients: "In France, there are few neurosurgical centers," says Levrier. "Stroke care is urgently needed."

The development of new procedures and technologies has led to a convergence of the two disciplines because they share the same space. The biplane system has been used more often, which has led to a quicker return on equity for the hospital. The support teams can now work in both specialties, which helps to boost efficiency and reduce overtime. This collaboration leads to better emergency management and knowledge sharing among interventionalists, thereby improving outcomes. >



**The Artis zee biplane system is used by cardiologists and interventional neuroradiologists, which means a quicker return on equity for the hospital.**



*“If you use a machine eight hours a day instead of four, it’s better. It’s that simple.”*

**Olivier Levrier, MD,**  
Head of Neuroradiology  
Clinique Clairval, Marseille, France



### **Selling it to the business side**

Such multidisciplinary cooperation is still unique in France, says Levrier. “We’re the only private hospital in France doing these kinds of neuro-interventions,” he says. “The others are university hospitals, where the biplane is usually dedicated to neuro. They aren’t so worried about financial issues.” The biplane system has brought clinical benefits in a number of different procedures including auricle closure, permeable foramen closure, and stroke management. It has also allowed the development of innovative spinal interventions in collaboration with neurosurgeons and reductions in contrast media use when imaging children.

Even a decade ago, Levrier knew that he and his colleagues needed biplane technology. But how could they justify the extra cost if the system were to lie dormant for half the day? With a few exceptions, such as pediatrics (due to the

*“We managed to bring together two very different specialties, along with the staff, the timetable, and the reception of emergencies. At the end of the day, it works well.”*

**Frédéric Collet, MD,**  
Head of Interventional Cardiology,  
Clinique Clairval

reduced need for contrast media), cardiologists feel that they can do the job with the single plane system.

So how about letting the cardiologists use the system the rest of the time? Even if they only require the single plane mode, at least it would still be in use, treating patients and generating revenue. "That was the business plan that I presented at the beginning, about ten years ago, to the manager of the clinic," Levrier recalls.

As technology and medical practices have evolved, an increasing number of cardiological procedures, including atrial appendage and patent foramen ovale closures, may benefit from the biplane technology, Levrier believes.

Head of Interventional Cardiology at Clinique Clairval for the last 25 years, Frédéric Collet, agrees that developments on both sides, such as auricle and paraprosthetic leak closures in cardiology, and coil and stent embolization techniques in interventional neuroradiology, have helped forge more joined-up thinking.

### Sticking to the schedule

Nobody remembers any problems or even a kink in the sharing process. They divided the five weekdays into ten half-day segments. With its greater stream of patients, cardiology had six of these segments and occasionally even uses a spare hour on the neuroradiology calendar. "Sometimes the interventional neuroradiologists have a light schedule and we can use the biplane," says Collet. "It depends." By optimizing the schedule, the hospital can avoid paying overtime to technicians, thereby saving money. Levrier adds: "There's no problem working together and sharing the room, as long as we have mutual respect. We can mix cultures. It's never a disadvantage. We feel enriched. It's really about human relationships."

### Learning from each other

Beyond the obvious, the human relationships are among the main benefits of the multidisciplinary approach. "It's quite exceptional to see this convergence," says Collet. "We managed to bring together two very different specialties, along with the staff, the timetable, and the reception of emergencies. At the end of the day, it works well."

**The collaboration across disciplines has led to efficient system utilization and brought versatility to the teams.**



The technicians have become proficient in both specialties. "It's better because it allows the staff to avoid doing the same thing all the time," says Levrier. "It's also good for the staff and the anesthesiologists to have this versatility."

Ultimately, for private hospitals, it all comes down to the bottom line. "It depends on the economic healthcare model, but one thing makes sense," says Levrier. "If you use a machine eight hours a day instead of four, it's better. It's that simple." ●

**Matthew Lenson** is an American science and healthcare writer based in Paris.

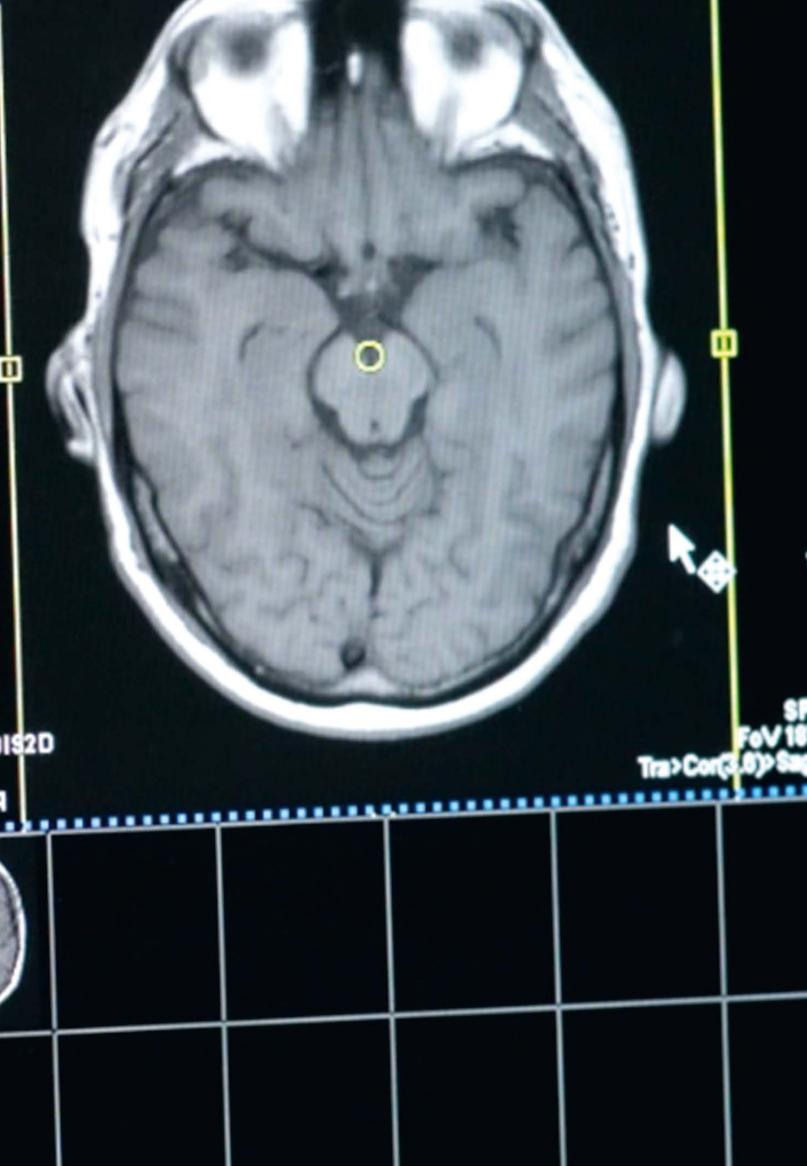
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## Digitalization in Radiology: Deploying Specialist Knowledge with a Virtual Scanning Cockpit

In the future, the growing need for radiology specialists could lead to more frequent bottlenecks. Now, thanks to the introduction of software to support remote scanning, radiology technologists at Essen University Hospital can operate up to three scanners at the same time, regardless of their location.

Text: Helen Baer



Software that enables remote scanning could help combat the shortage of specialists in radiology.

**T**he number of MRI and CT scans is increasing, but there is a growing shortage of suitable specialist personnel to operate the equipment. According to Professor Michael Forsting, Director of the Institute of Diagnostic and Interventional Radiology and Neuroradiology at Essen University Hospital, the lack of skilled radiology technologists could become a problem for Germany in the future. "Although there are no bottlenecks in care at the moment, it's becoming increasingly difficult to staff these services. The system is nearing a tipping point – if we don't act now, we'll face a real shortage in a few years' time and will no longer be able to provide appropriate patient care."<sup>[1]</sup>

## The changing job description of radiology technologists

The shortage of skilled workers is primarily due to the demanding nature of the job, which carries a high level of responsibility – and a considerable workload – for too little pay. It also involves working at night, at weekends, and on public holidays. Furthermore, the job description has become much more complex in recent years, during which modern diagnostic imaging procedures such as MRI/PET and CT/PET have consistently expanded the range of tasks required of radiology departments. Continued professional training and specialization are required in order to fulfill the principal requirement of the job: creating and processing images of the highest diagnostic quality.

The introduction of new IT solutions has transformed the variety of tasks performed by radiology technologists – from scheduling, preparing, and positioning the patients, to running the scans and managing the equipment. In particular, the growing use of artificial intelligence (AI) means that, in future, radiology technologists will increasingly take on the role of supervisors.<sup>[2]</sup>

## Radiology technologists as supervisors in the Virtual Scanning Cockpit

The shortage of qualified personnel was also keenly felt by the radiology department of Essen University Hospital. "If you really have a shortage of technicians and you have to decide every morning whether you have to close a machine, yes or no, that's not really convenient. I mean we totally reduced that down to zero," says Professor Forsting. The introduction of *syngo* Virtual Cockpit allows radiology technologists to operate up to three devices at once regardless of their location. It has also been possible to reorganize the original tasks related to patient and scan management thanks to the centralization of specialists in a single "cockpit."

"We have defined two new areas of work: Firstly, patient management at the scanner where a medical assistant supervises and positions



Anton S. Quinsten,  
Chief Radiographer,  
Essen University  
Hospital working in  
the scanning cockpit.

patients. And secondly experts, who we call ‘virtual imaging specialists’ and who we train accordingly,” says Anton Quinsten, senior radiology technologist at the Institute of Diagnostic and Interventional Radiology and Neuroradiology at Essen University Hospital. On the one hand, the new way of dividing up the tasks makes it much easier for the staff at the scanner to prepare the individual patients as well as ensure a safe operation of the scanner device, while the specialists in the scanning cockpit can focus entirely on creating diagnostic images in order to guarantee consistently high image quality. In addition, the more-efficient workflows make the examination shorter, which simultaneously reduces waiting times for patients.

The introduction of a virtual cockpit leads to a wide range of new capabilities. In turn, these capabilities not only optimize everyday radiological practice in one’s own institution, but also make it easier to provide specialist care in rural areas.

### Ready for a digital future in radiology

With advancing digitalization, new IT and software solutions are set to play an increasingly significant role in the future when it comes to improving diagnostic accuracy and therapeutic success. “As a radiologist, you’re always pretty open to new technologies, but in the end, our aim is always to increase patient convenience and medical quality – and *syngo* Virtual Cockpit is a great help in this regard,” says Professor Forsting. ●

Helen Baer is an editor at Siemens Healthineers.

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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.



Professor Michael Forsting, MD, Director Institute of Diagnostic and Interventional Radiology and Neuroradiology, Essen University Hospital, Germany

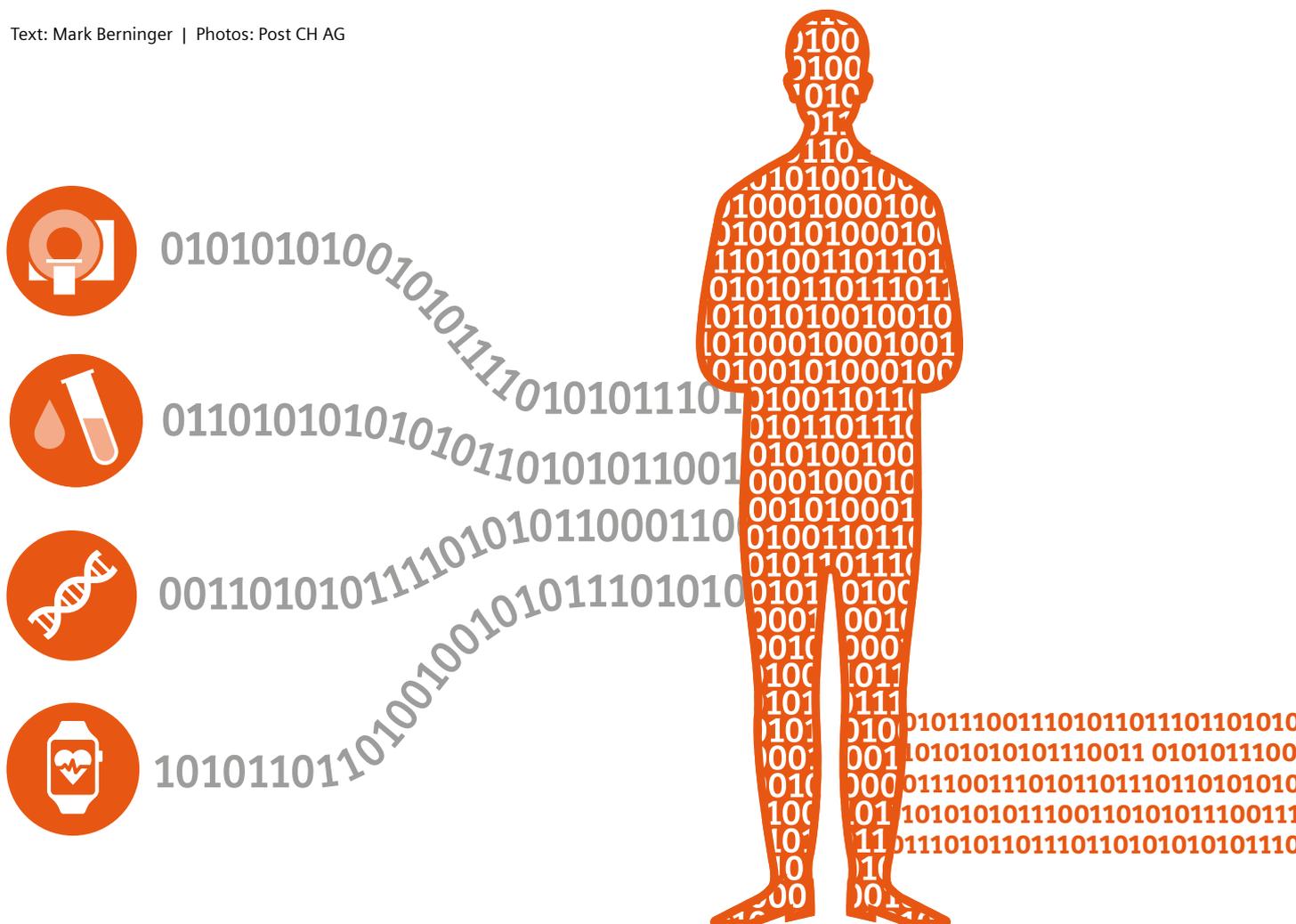
### Supporting colleagues and rural areas via remote access

In addition to everyday clinical practice, *syngo* Virtual Cockpit also makes it easier to communicate and collaborate with colleagues outside one’s own institution. Physicians and hospitals in structurally weaker regions can link up with specialists and thereby provide optimum diagnostic care. Experienced radiology technologists connect to different devices via remote access and provide less-experienced colleagues with the necessary support for rare or specialized procedures. This saves patients a very long journey in some cases or eliminates the need to transfer them to other facilities.

# Digitalizing Switzerland's Healthcare

By introducing electronic health records (EHRs) in Switzerland, Swiss Post is assuming a key role as a provider of digital infrastructure and services. The company relies on the eHealth solutions offered by ITH icoserve, a subsidiary of Siemens Healthineers. Martin Fuchs, Head of Digital Health at Swiss Post, talked about the developments in Switzerland.

Text: Mark Berninger | Photos: Post CH AG



**W**hich services is Swiss Post offering in connection with the introduction of the EHR?

**Martin Fuchs:** We are committed to transmitting health information securely and confidentially between all actors involved in healthcare throughout Switzerland. We provide the necessary infrastructure on the basis of the IHE standard required by law to the core communities that offer EHRs. In addition, we offer process support and special eHealth services to effectively implement the EHRs.

**Why did Swiss Post choose Siemens Healthineers as its technology partner for this project?**

**Fuchs:** We chose Siemens Healthineers as our technology partner because it had already run several eHealth projects successfully in other countries. The software is also very mature and the company has a clear strategic focus on a standards-based platform. Since we'll be offering a running, certified system by April 2020, it was very convenient that we could build on the experience that Siemens Healthineers had gathered with Austria's electronic health record, the ELGA, which is designed very similarly to ours.

**How does the collaboration with Siemens Healthineers work?**

**Fuchs:** From the outset, we jointly presented to our customers, the core communities.

People have a high degree of trust in Swiss Post when it comes to reliability and handling sensitive information. In addition, our customers value Siemens Healthineers for its extensive experience in realizing such projects, its focus on solutions, and its knowledge of the specific standards that need to be implemented.

**How is Switzerland financing the introduction of the EHR?**

**Fuchs:** The financing varies a great deal between the various core communities. In some cases, the canton is paying for it using tax revenues. In others, it's financed via membership fees that should eventually pay off. For the startup phase, the communities also receive subsidies from the national and cantonal governments. The major benefit of the EHR is that it provides patients and medical professionals with easy access to health information and allows them to share it easily.

**Aside from the feasibility of technical interoperability on the basis of the IHE standard, which insights from the process so far do you think are interesting for the situation in other countries?**

**Fuchs:** Probably the biggest difference is that Switzerland is taking a top-down approach. Service providers are legally obliged to participate in the EHR. We also have a clear timetable, and sanctions will be imposed if the goals aren't met.



*“We chose Siemens Healthineers as our technology partner because it had already run several eHealth projects successfully in other countries. The software is also very mature and the company has a clear strategic focus on a standards-based platform.”*

**Martin Fuchs**  
Head of Digital Health at Swiss Post

**What are the next steps on the road to EHR introduction?**

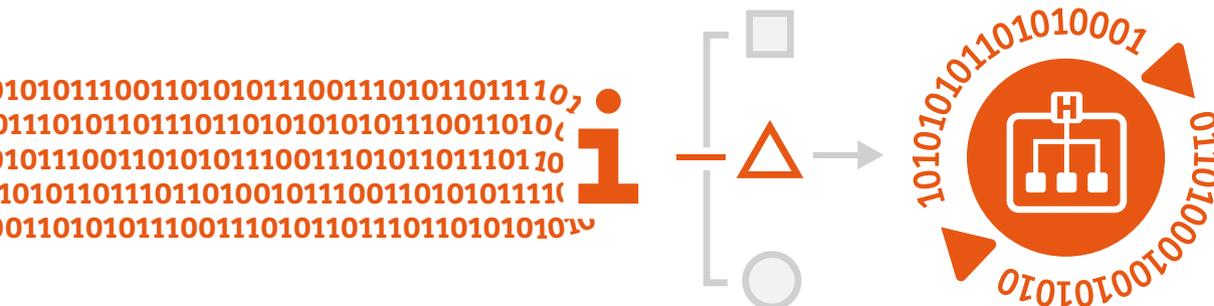
**Fuchs:** There’s still a great deal to do. One key milestone is the technical certification, and a few details still need to be clarified – such as how patients enter the core community of their choice. However, thanks to our Siemens Healthineers-supported platform, we’ll be able to provide the core communities with a certifiable solution for the EHR and a wide range of value-added services by the end of 2019. ●



Martin Fuchs is in charge of Swiss Post’s electronic health records (EHRs) project.

**Electronic Health Records: An overview**

In April 2017, Switzerland introduced a law requiring electronic health records (EHRs) to be rolled out nationwide by 2020. The aim is to improve the quality of medical care, enhance treatment processes, increase patient safety, make the healthcare system more efficient, and encourage health literacy among patients. These electronic health records will allow patients to decide who can access their data. The principle of double voluntary action also applies – in other words, patients are just as free to decide whether or not to use the records as private practice physicians and pharmacists are. However, hospitals as well as rehab centers and psychiatric units on cantonal hospital lists will be obliged to participate in the scheme from 2020. The law will apply to retirement and care homes from 2022. So that patients can move around the country and service providers can access their health records from anywhere, Switzerland’s cantons and hospitals have formed *Stammgemeinschaften* or “core communities” which store data locally and organize information sharing via IHE profiles.



# The Future of Clinical Diagnostics

A team of radiologists and IT experts at the University Hospital Basel, Switzerland, are working with Siemens Healthineers to develop AI solutions for the hospitals of tomorrow. The idea is to use algorithms throughout the clinical diagnostic process – and enable diagnostics to keep up with the constantly growing demands it is facing.

Text: Philipp Grätzel von Grätz | Photos: Philip Frowein

**T**he University Hospital Basel is an impressive complex located near Basel's historic city center. A few steps further, directly on the picturesque Rhine river, several clinical research groups share a building. Patients don't usually come to this location, yet thousands of digital patient records move around here all the time. On the ground floor, four radiologists, five data scientists, and one pathologist sit facing two dozen large screens as they work on the algorithm-based future of clinical diagnostics.

## Algorithms for more accurate biopsies

Bram Stieltjes, MD, PhD, himself a radiologist, leads the working group. He is not only Head of Radiology Research at the University Hospital

Basel, but was recently made Head of IT Research, too. So he is kept busy. Just recently, one of Stieltjes' employees left for a year at Siemens Healthineers research center in Princeton, USA – one of the most important centers for artificial intelligence (AI) and machine learning in radiology. The collaboration with Princeton could give impetus to many ambitious AI research and development projects, including one that is particularly close to Stieltjes' heart at the moment.

The project relates to prostate cancer patients facing biopsy. The vision is that magnetic resonance imaging (MRI) datasets of the prostate will be automatically segmented using machine learning and that the algorithms will then help indicate the best site for a biopsy. This information will not end up



**Bram Stieltjes, MD,**  
Head of Radiology  
Research and Head  
of IT Research,  
University Hospital  
Basel, Switzerland.

in a report, but will be directly transmitted to an ultrasound device in the form of an annotated image. “The doctor who makes the ultrasound-guided biopsy no longer has to deal with different images and findings,” says Stieltjes. “He or she has all the necessary information on the image itself, which facilitates an accurate biopsy.”

The prostate project, which is still in the early planning stage, is so exciting for Stieltjes, because it shows how a complete clinical diagnostic process involving different imaging modalities could be digitally integrated with the help of machine learning algorithms: “I think this is the direction we should be going. Clinical care will gain most from this approach.” >



Bram Stieltjes is working on the automated segmentation of MRI datasets of the prostate based on machine learning.

A hospital cannot handle development projects like this alone. In addition to academic partners, it also requires close cooperation with companies offering hardware and software solutions for clinical diagnostics. Siemens Healthineers is a key cooperation partner of Stieltjes and his team. “The core idea of our group is to be a bridge connecting industry with clinical and academic research. We can develop prototypes relatively fast and test them in a clinic-like environment.”

### Need to improve data preparation and IT Integration

A good example of the possibilities, but also the difficulties, of using AI in diagnostics is a prototype AI system for X-ray and computed tomography (CT) examinations developed by the University Hospital Basel. The aim is to deliver a quick diagnosis for those patients requiring it, such as those with fractures or bleeding. “We have two problems,” says Stieltjes. “Three out of ten patients without clear symptoms have an acute pathology. And, conversely, nearly half of the patients classified as priority cases by clinicians turn out not to be urgent cases after all.”

The Basel team has therefore trained an algorithm to differentiate acute cases from normal findings and to prioritize patients on the radiology worklist accordingly. “It works extremely well from both a technical and a clinical perspective, and our clinicians are enthusiastic,” says Stieltjes. However, integrating it into the clinical processes proved difficult, not owing to the algorithm, but to the available IT infrastructure.

“Unfortunately, because of the way we process clinical data in radiology, we are not really ready yet for self-learning algorithms. There is still a lot that needs to change.” As an example, Stieltjes says that it should be considered whether there will still be a written diagnostic report in the future or whether radiologists should rather just annotate the images. For algorithms that would be much more practical. And it would probably make no difference to the clinicians.

### Sophisticated support for thoracic examinations

AI-Rad Companion<sup>1</sup> from Siemens Healthineers, which was launched at the 2018 convention of the North American Radiological Society (RSNA) in Chicago, has successfully passed the prototype stage. Bram Stieltjes and the Basel working group continue to be closely involved in the ongoing development of this platform.

The tool aims to support radiologists with diagnosis – at present only with CT images of the thorax: “This includes measurements of the aorta, detecting fractures, and COPD diagnostics, among others,” says Stieltjes.

The algorithms are trained using large, quality-assured datasets. The platform takes pressure off the radiologist and optimizes the quality, but above all, the consistency of the diagnostics. Overall, Stieltjes considers the algorithms that have been developed to be very well engineered. However, relatively large amounts of training data are needed if the algorithms are also to cope with patients who have more unusual anatomies or findings. “You notice how the systems were trained,” says Stieltjes. Normal or slightly pathological findings are commonly over-represented. So, often the results of validation studies cannot be transferred directly to clinical collectives.

However, Stieltjes emphasizes that it is by no means always the algorithms that are wrong: “When radiologists create a report, there is a variability of about ten to 20 percent depending on the author. In an algorithm-based diagnosis, this variability is completely eliminated and the results are very consistent. That alone is a huge advantage of AI platforms like the AI-Rad Companion,” says Stieltjes.

## Algorithms for integrated decision support

Another Siemens Healthineers application that the Basel group is currently evaluating at the prototype stage is the AI-Pathway Companion<sup>2</sup>. “This application is about integrated decision support,” says Stieltjes. It aggregates and analyzes patient’s longitudinal data, along with results from imaging, laboratory, pathology and clinical studies. Using this as the basis, the system automatically maps the patient’s status on the clinical pathway, taking evidence-based clinical guidelines into consideration, and recommends the next steps.

AI algorithms are also used to quantify risks and to predict the individual course of disease. In cases of prostate cancer<sup>3</sup>, for instance, the software supports the work of the tumor boards and facilitates interdisciplinary collaboration. “Clinically, the ultimate goal is to decide about the most appropriate treatment for the individual patient,” says Stieltjes. But the software can also be used for process optimization, he says, for example by analyzing how many diagnostic steps were needed to reach a particular decision.

## Driver for digitalization

All in all, Stieltjes is optimistic that it will soon no longer be a case of individual radiology departments using individual AI applications for very specific purposes: “In five to ten years, there will be hardly any diagnostic processes that are not supported by AI.” He says one of the factors behind this will be the growing pressure on the diagnostic fields as a result of ever-increasing and more extensive examinations and data sets: “The data volume in medicine doubles every two to three years. That’s a huge driver for digitalization.”

Stieltjes refers to a study from the U.S., which found that 50,000 new diagnostic positions would have to be filled in the national health-care system over the next ten years to meet growing demand: “With human resources alone we cannot meet these challenges. If we don’t change our processes and use more AI algorithms, diagnostic quality will decrease. We need new tools to deal with the flood of data we can expect.” ●

Philipp Grätzel von Grätz is a medical doctor turned freelance writer and book author based in Berlin, Germany.



The University Hospital Basel, Switzerland, a bridge between industry, academic, and clinical research.

<sup>1</sup> AI-Rad Companion is 510(k) pending, and not yet commercially available in the United States and other countries, and its future availability cannot be ensured.

<sup>2</sup> AI-Pathway Companion is under development and not commercially available. Due to regulatory reasons its future availability cannot be ensured. CE Mark pending.

<sup>3</sup> AI-Pathway Companion Prostate Cancer and AI-Pathway Companion Prostate Cancer Analytics VA10A are currently under development and planned to be commercially available in 2019. Due to regulatory reasons its future availability cannot be guaranteed.

# Partnership Models: Adding Value, Enabling Innovation

In an increasingly complex healthcare system, 'going it alone' is an obsolete approach. Partnership models create new opportunities at all levels and allow hospitals to keep innovating even under difficult circumstances.

Text: Philipp Grätzel von Grätz | Illustrations: Jens Amende

**I**n modern healthcare systems, hospitals are exposed to a great deal of pressure. Financial resources are finite. Not least due to demographic change, staff are in increasingly short supply. And at this transitional stage on the path to a knowledge society, providers of inpatient treatment face the challenging task of managing steadily increasing data volumes.

Peter Gocke, MD, is the Chief Digital Officer of Charité, Berlin's oldest hospital, and one of the biggest in Europe. In May 2019, at the Hauptstadt-kongress event, Germany's premier convention for the medical and healthcare sector, he noted that in such an environment, access to data and technology is of enormous importance: "Ultimately, hospitals want to practice better medicine. Digitalization and the availability of data make this possible, while providing better security for patients." However, he explained, this can only succeed when taking into account the complex organic nature of a modern hospital environment: "We need to relieve pressure on our doctors and caregivers and provide digital services not only to patients, but also to their families. We must transcend sectoral boundaries and eliminate the two-track administration of research data and care data."



Partnerships foster innovation planning, workflow optimization, and better collaboration among stakeholders.



## Interoperable platforms facilitate cooperative models

One important component of this process, as Gocke points out, are digital platforms that can merge a hospital's data in a structured format while also allowing outside partners to interact digitally with the institution in question. This may be required, for instance, in connection with clinical studies or registries, for collecting patient-reported outcomes, or for making use of digital apps and algorithms.

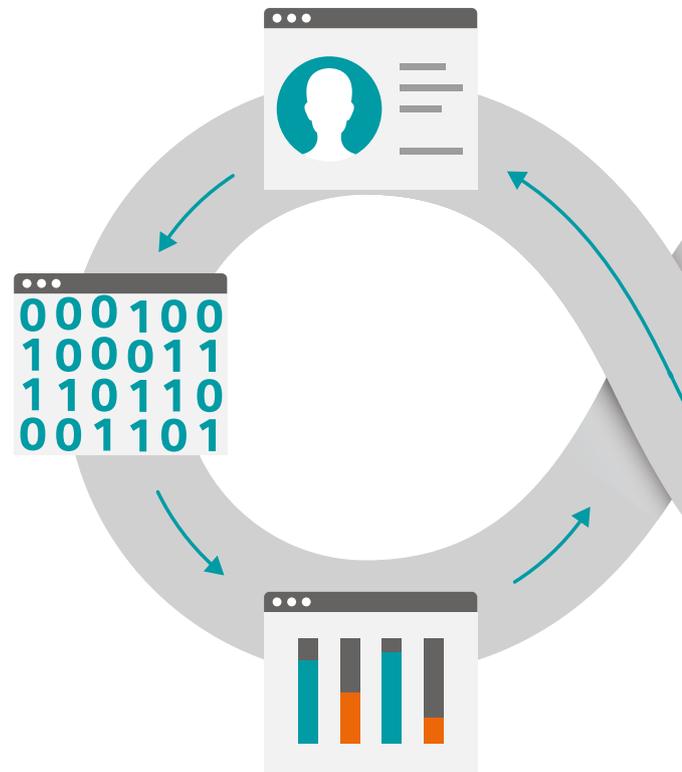
In close cooperation with industry partners, Charité is currently developing an interoperable data platform geared toward cooperation and data availability. And, as Gocke emphasizes, the effort is already bearing fruit: An alert algorithm is, for example, being implemented throughout the hospital to prevent patients with incipient kidney damage from slipping into acute kidney failure. A number of other potential applications are conceivable, he believes, once a hospital breaks down its data silos.

## Eliminating investment backlogs through technology partnerships

Overarching data platforms for entire hospitals are one area where it makes sense for a hospital to enter into cooperation with industry partners and other institutions. Another area where cooperation can help overcome the challenges facing hospitals is the field of medical technology. For instance, Klinikum Braunschweig (Braunschweig Medical Center) has entered into a technology cooperation with Siemens Healthineers to help resolve the investment backlog affecting diagnostic and therapeutic medical equipment, without losing sight of economic efficiency.

"Our aim was to further sharpen the profile of our flagships, such as the oncology department, while at the same time ensuring and scheduling the modernization of large-scale equipment across the entire hospital," explains Managing Director Andreas Goepfert, MD. To this end, even before calls for tenders were issued, the center's medical technology experts sat down with service providers as well as the hospital's administration and controlling sections for some highly structured preliminary debates on the necessary requirements.

"Because they allow for longer-term contracts, technology partnerships are well suited to taking better advantage of useful innovation leaps,"

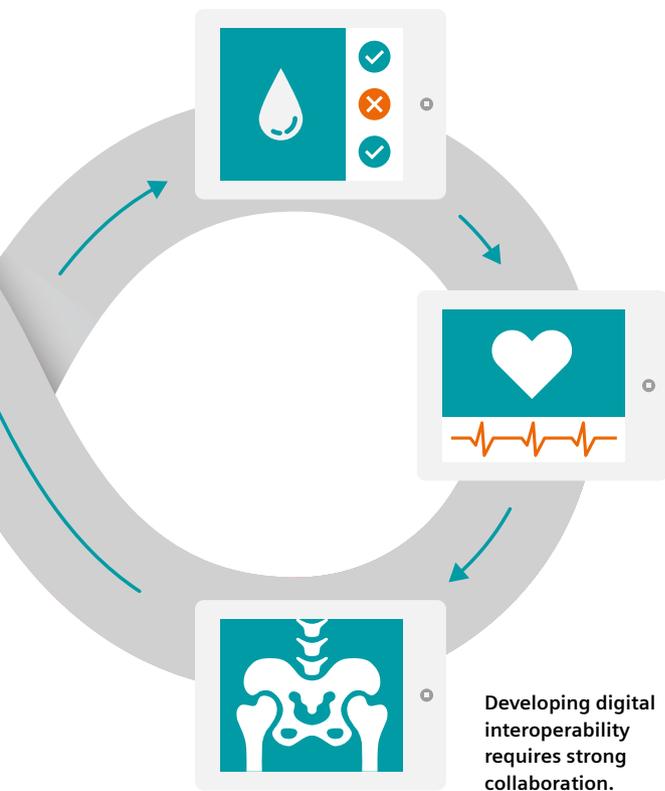


Goepfert emphasizes. At the same time, processes can be optimized and staff needs addressed, not least because the standardization of the equipment fleet eliminates discrepancies in operational philosophy and mitigates the problems associated with interfaces.

"For us as manufacturers, such partnerships are becoming increasingly relevant," as Soeren Eichhorst, MD, PhD, Global Head of Healthcare Consulting at Siemens Healthineers, explains. He points out that partnership models are extremely flexible constructs. In the interests of fostering value partnerships, they may include not only innovation planning and consulting on workflows and work processes, but also pay-per-use agreements and risk-sharing approaches.

## Employee satisfaction increasingly important

The RHÖN-KLINIKUM AG company maintains a technology partnership with Siemens Healthineers based at its Bad Neustadt campus. Stephan Holzinger, CEO of RHÖN-KLINIKUM AG, argues that partnerships should be conceived even more broadly. While cost-sharing and quality improvement are important, he says: "Within



our organization, we are going further and considering options for entering into partnerships that support employee retention and staff recruitment.”

By way of example, Holzinger cites the company's cooperation with an IT firm that provides easy access to corporate employee benefits, ranging from childcare to a package delivery service. At the University Hospital of Giessen, an app is being evaluated that optimizes patient calls with the aim of minimizing unnecessary foot travel, internally referred to as “sneaker time”. To support the doctors' work, the hospital and an Austrian partner company are jointly developing a medical cockpit that uses scanning and semantic analysis to process documents provided by the patient in a way that allows the physician to identify key information that is relevant to the treatment path within seconds.

## Building networks for research and care

Looking beyond partnerships with IT companies, medical technology providers, or startup companies, hospitals operating in a modern healthcare system are also increasingly dependent on

traditional forms of networking with collaborating institutions. To be able to provide high-end medical care at a time when Germany's two-tier hospital financing system no longer suffices to cover the innovation requirements, Heidelberg University Hospital, for example, cooperates closely with other clinics in the vicinity, based on 53 cooperation agreements. There are similar agreements with 45 doctors' practices.

Cooperation models between hospitals are indispensable, especially when it comes to research – a point emphasized by Professor Heyo Kroemer, MD, Dean and Speaker of the Board of University Medical Center Göttingen: “The concept of a solitary clinic that brings together all available technologies under a single roof is a thing of the past.” In the field of genome sequencing, for example, he notes that it is not possible for a single institution to build up all of the necessary capacities. Instead, a national infrastructure is required here, as also recently suggested by the working group on infrastructure at the German Federal Ministry of Education and Research (BMBF).

Kroemer believes genome sequencing is also a good example of a scenario in which partnership models that originated in research and development ultimately also become important for medical treatment. For in times of precision medicine, genetic sequencing is swiftly becoming part of everyday diagnostics and therapy.

Kroemer, set to become the new director of Berlin's Charité, expects a similar “diffusion” into healthcare in the case of the Medical Informatics Initiative, an ongoing large-scale program funded by the BMBF. Under this umbrella, university hospitals have formed several consortia that aim to build up joint patient databases with the help of numerous industry partners, including Siemens Healthineers. This will allow research across multiple institutions and support the implementation of big data projects aimed at improving medical treatment in areas such as intensive care, antibiotic therapy, or sepsis. ●

**Philipp Grätzel von Grätz** is a freelance medical and healthcare journalist based in Berlin. He is specialized in digitalization, technology, and cardiovascular therapy.

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.



A hybrid OR at Diakonie Klinikum Jung-Stilling in Siegen, Germany. This is a good example of medical devices as part of an holistic user experience in the workplace.

# Medical Technology Design as a Strategic Success Factor in Hospitals and Practices

Clinical staff and patients no longer see medical devices as merely technology with clinical functions. They want to enjoy using the technology and are seeking an holistic product experience.

Text: Susanne Bay

**"M**edical devices just have to work and be able to be operated without any errors." Anyone who still holds this attitude when purchasing medical technology has clearly missed some major trends in the healthcare sector. High-quality design has become a key factor in procurement decisions. And this is not simply because good design improves functionality and makes it easier to integrate the device into hospital workflows. It's also because "joy of use" has become an important criterion. This means that medical staff, from doctors to medical technologists, should be enthusiastic about a new high-tech device and enjoy working with it. Medical devices that fill people with enthusiasm can make it easier to recruit and retain employees. This is one side of the trend.

On the other side, we have the new expectations that patients have of the hospitals to which they are admitted. Modern exterior architecture and interior design are no longer the only factors that matter – the appearance of the medical devices also counts. For example, a device with multiple buttons and controls risks unsettling the patient who is being examined. He or she might worry that the technical staff cannot possibly fully master a device that looks this complex. If these kinds of challenges and requirements

linked to the use of medical technology are to receive sufficient attention at the product design stage, designers must be willing to engage with medical staff and patients. Nowadays, it is not uncommon for hospitals with cutting-edge, patient-friendly medical technology to use it as a way of publicly promoting themselves.

## Usability guidelines provide a framework for design

Medical product design, however, must comply with tough standards on fitness for purpose. National organizations, such as TÜV in Germany and the FDA in the United States, check that devices meet these standards. The aim is to make sure that products are safe for patients and users, and to rule out human error (such as treatment errors). Then there are design guidelines on usability. The idea here is that users should be able to operate the medical products effectively, efficiently, and satisfactorily. In healthcare, the main aim is to reduce time and costs via optimized processes and accuracy, while increasing reliability and the quality of the results. Usability guidelines also stipulate that designers should orient products toward human capabilities so that they eliminate or at least minimize physical and mental strain. >

Another key criterion is that the devices must offer uniform, consistent handling so that employees can work efficiently and flexibly at different workstations within a department. This is the finding of an internal study carried out by Siemens Healthineers, in which healthcare industry representatives were consulted on issues such as managing fleets of medical devices. Siemens Healthineers, for instance, guarantees product consistency and coherence through internal design guidelines and the use of a single software.



Although they have to comply with numerous safety regulations, medical technology designers have a great deal of freedom. Each year, they create excellent (and in some cases award-winning) formally aesthetic design solutions and complete design systems for portfolios. Examples include ARTIS pheno, MAGNETOM Vida, and the User Interface Framework from Siemens Healthineers.

## Aesthetic design brings joy to technology use

Design rules make sense and are important in allowing the medtech sector to manufacture safe, user-friendly products that fulfil their purpose. Yet, medical devices cannot win over patients and staff with functionality alone. Nowadays, aesthetics and attractiveness are undoubtedly distinct factors that can make interacting with technology a joy. This area concerns the physical design of a system or object – aspects such as the visual, acoustic, tactile, and haptic qualities of a software or hardware interface. In other words, we are talking about forms, colors, materials, and static as well as dynamic features. An inviting design can bridge the emotional and physical distance between a person and an examination device. New kinds of stimulation from, say, a mood light or images, can deliberately help steer the patient’s focus. The right choice of materials and design can make interacting with control elements a pleasant tactile experience. Marks of quality showing that a device is made of high-grade material are useful in expressing a medical institution’s own high standards.

According to researchers at Princeton University, it takes us just one tenth of a second to make our minds up about other people.[1] We’re even faster online: Website users need just 50 milliseconds to decide if they like a website and want to stay on it.[2] The critical factors here are colors, forms, symmetry, and visual complexity. A design’s attractiveness therefore plays a crucial role in whether or not all stakeholders accept the system. It can immediately create positive experiences – for patients, for technical staff, and for the directors of medical facilities. To achieve this, Siemens Healthineers applies internal design guidelines to designing devices, software interfaces, icons, packaging, and communication materials. This allows us to create an all-round, high-quality product experience using a single design language that expresses our brand promise across all customer touchpoints with our systems.

## Positive user experiences are key

So are usability and aesthetics the core qualities that will win over staff and patients? Not quite. A positive experience of using the system is also key – which is why designers have to consider the concept of user experience. This term covers

the experience of a person has before, during, and after interacting with a product or service. It takes account of subjective, emotional, and social aspects.

ARTIS pheno, for instance, is a robotic-assisted angiography system primarily used in surgical environments. Besides fulfilling hygienic and safety requirements, the challenge for Siemens Healthineers was to give this powerful machine an appearance that would build trust among both users and patients. The system had to look friendly and safe, but it also had to show that this is a precise and sophisticated medical device. The solution? Clear-cut forms that allow observers to easily survey and understand the system's configuration. The robot was deliberately designed to move in a calm, steady way. The result is an impressive sculpture whose movements are an elegant combination of power and grace.

## Trend: Human-centered design as a strategy

Designers have changed the way they perceive technology. They now design technology for by placing the users, their problems, and their needs at the start of the process. This human-centered design combines user experience and design thinking. Design thinking is a structured approach to solving problems and generating innovation. Users' motives and needs are the starting point for developing ideas and innovation. The solutions are developed and optimized iteratively through multiple prototypes and feedback loops with users. This integrated approach to product design includes the workflows used by clinical employees, their own personal experience, and the patients' experience.

Radiology technologists, for instance, often say that they want to be able to stay closer to their patients while they work. After engaging intensively and globally with this user group, Siemens Healthineers developed SOMATOM go., a new computed tomography platform. Its tablet-operated mobile workflow allows medical employees to put patients at the heart of their work. To increase patient comfort even further, the scanners also offer special lighting and light projections. These can help children overcome their fear of the device, for example.

In the coming years, new technologies, increasing automation, and artificial intelligence will radically change the tasks that medical employees



perform. Applying human-centered design to medical technology can help strategically shape the work so that humans can make optimal use of their abilities, and the machines can take over subtasks without forcing the operator to relinquish all control.

**SOMATOM go. platform from Siemens Healthineers puts the focus on patients.**

In this sense, design becomes a strategy and involves a great deal more than simply creating a visual appearance. If a company considers user experience as a fundamental part of product development, adjusts its organization accordingly, and concentrates on the experience it provides to users and customers, it will be more successful. Studies back this up: The consultancy firm Gartner rates customer centricity as one of the most important trends for 2018 and 2019.[3]

Today's technical staff and patients want to enjoy interacting with medical technology. The devices must therefore combine usability, aesthetics, and user experience to achieve an holistic product experience. This has the potential to raise employee satisfaction and retention rates, improve patient wellbeing, and secure long-term success for healthcare providers. ●

**Susanne Bay, PhD**, is Head of Strategy and Innovation for Design and User Experience, Siemens Healthineers.

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# Solutions for Individual Patients

To tailor cardiological treatment much more closely to the individual patient, scientists at the Clinic for Cardiology at Heidelberg University Hospital, Germany, are working to develop a digital twin of the heart. Professor Benjamin Meder, Deputy Medical Director of the Department and Head of the Institute for Cardiomyopathies in Heidelberg, reveals how far the work has advanced.

Text: Philipp Grätzel von Grätz | Photos: University Hospital Heidelberg

**P**rofessor Meder, just what exactly is a digital twin of the heart?

**Professor Benjamin Meder, MD:**

The term 'twin' is symbolic of the representation of a patient that closely reflects the structure and function of his or her heart and potential heart disease. The digital twin is an incredibly individualized approach in medicine. And we not only want to use it for diagnosis, but also to test the safety of treatments. For example, we could test certain cardiac drugs on the digital twin heart to see how effective they were. Or we could digitally simulate cardiac catheter interventions and heart surgery in advance and only go ahead with them if there's a realistic chance of success. For this to work, we need to simulate the biology of the real heart as

accurately as possible, which is why molecular information, in addition to clinical investigations, is certainly useful.

**So can a digital twin of the heart go beyond other models of cardiovascular risk prediction?**

**Meder:** Cardiology uses various risk models: For example, measuring the highly sensitive troponin or the ejection fraction of the left ventricle already tells us a great deal about a person's risk of disease. But in individual patients, this simplification to a few variables is often not meaningful enough to predict the effectiveness of a therapy. In future, more complex models such as a digital twin of the heart could allow us to test a variety of therapy options in





Professor Benjamin Meder, Deputy Medical Director and Head of the Institute for Cardiomyopathies, Heidelberg University Hospital, Germany



Therapies with a certain risk, such as cardiac surgery, ideally are simulated for outcome in advance, according to Professor Benjamin Meder of Heidelberg University Hospital. This is one area where AI is of huge importance.

advance. What's important here is that we find solutions that suit an individual and not just general statements that match a risk group.

**You've been working on this project for around six years. What were or are the major challenges?**

**Meder:** In addition to all the technical challenges, we need to establish reliable cooperation between different areas of expertise. This includes the cooperation between industry and the university. I think that in future we'll need to work

together much more closely when it comes to artificial intelligence, or AI, because each field has unique capabilities and offers its own approach to solutions. The strengths of physicians lie in the recognition of medical needs and ethical questions, in the precise path to a solution without disregarding risks. In Heidelberg, we also have decades of expertise in molecular cardiology and understand very well how diseases progress from cause to organ failure. The strengths of industry lie in knowing how to implement technology.

*“Algorithms will help us track the distinct progression of heart diseases and adapt those learnings to each new patient.”*

**Professor Benjamin Meder**, Deputy Medical Director and Head of the Institute for Cardiomyopathies, Heidelberg University Hospital, Germany

#### **What specific applications of the digital twin are you working on?**

**Meder:** First of all, thanks to AI technologies, better diagnostic methods that can integrate a huge amount of data will be available in the near future. Algorithms will also help us track the distinct progression of heart diseases and adapt those learnings to each new patient. Moreover, I think it's important, especially in the simulation of procedures using heart catheters or surgery, to avoid risks and so that we can perform the intervention as well as possible. With a heart operation or intervention, everything must be just right. You don't have a second and third chance like repairing a car, so therapies with a certain risk have to be planned in advance and, ideally, simulated for outcome. Even today, an interventional cardiologist mentally simulates an upcoming intervention. But wouldn't it be great if this 'biological simulator' always had the same quality? To help achieve this, Heidelberg has now announced an opening for a professorship in 'Artificial Intelligence in Cardiovascular Medicine' and established the 'Informatics for Life' program, which brings together a large number of talented cardiac and computer researchers – and hopefully also the best companies as partners.

#### **What's the current status of the project? Have algorithms already been developed for certain predictions or simulations?**

**Meder:** We'll be building a new cardiac center in Heidelberg that will not only provide excellent cardiac medicine, but also serve exactly that purpose: Data should be used in the patient's interest, in a protected and trustworthy environment to develop cardiac medicine 4.0. Only companies with the same high standards can become partners in this setup. One specific algorithm that we're already evaluating concerns the prediction of cardiac resynchronization therapy (CRT). This is, so to speak, our pilot project, and we're working on it together with Siemens Healthineers – as presented recently at a conference at the renowned Isaac Newton Institute in Cambridge. The challenge with CRT is that we haven't been able to accurately characterize the patients who benefit from this treatment. As a result, patients receive implants without much benefit, and patients who might benefit aren't receiving them or receive them too late. Here we want to use the digital twin to make sure we can treat patients in a more targeted way. The first study on this question is currently in data evaluation. We hope that we'll be able to publish the results soon.

#### **Are there specific challenges in the clinical application of such algorithms? And what implications do they have for clinical trials?**

**Meder:** Clinical trials allow the objective testing of new procedures and must precede any routine treatment. But in the age of precision medicine, the studies will look different. Great importance will be attached to understanding the individual study participant as best as we can. The approach of the digital twin helps in this respect. In fact, I'd argue that there isn't a comparable approach worldwide that can better support our understanding of heart diseases of individual patients. Hopefully the next few years will show that this can make a significant contribution to cardiac health. ●

**Philipp Grätzel von Grätz** is a freelance medical and health-care journalist based in Berlin. He is specialized in digitalization, technology, and cardiovascular therapy.

# A Hybrid Approach: Minimally Invasive, Image-Guided Surgery in Asia

With the rich past of a former capital of commerce and power, the Taiwanese city of Tainan has many claims to fame. Its latest is the trailblazing work in minimally invasive, image-guided surgery.

Photos: Chia-Min Chang

**T**he metropolitan area around Tainan has a population of three million who demand state-of-the-art medical treatment. Hospitals in Taiwan experience fierce competition for patients which can only be won with the latest treatment methods and technology. Robotic surgical systems and hybrid operating rooms are integral to modern Taiwanese healthcare. X-ray imaging capability in operating theaters is a must to provide minimally invasive therapy options.

Chi Mei Medical Center in Tainan, Taiwan, just celebrated its 50<sup>th</sup> jubilee. The hospital has grown with the city and now accommodates 2,450 beds. After installation of the first surgical tele-manipulator in Southern Taiwan, Chi Mei Medical Center reached another milestone with the commissioning of a new hybrid operating room equipped with a robotic imaging system. The hybrid operating room in Chi Mei is available to clinicians from many disciplines and is a critical stop for many patients along their care path. Thoracic surgery is just one example of the many procedures performed here, but it is an important one in Taiwan.





## **Lung cancer screening and thoracic surgery**

Along with Taiwan's economic success came the inevitable air pollution. Furthermore, Taiwanese people love to cook, but often in poorly ventilated spaces directly exposed to greasy aerosols. Regardless of where the blame lies, here or in as-yet undiscovered hereditary factors, a long-term observational study has revealed that Taiwanese non-smokers are more likely to suffer from lung cancer than smokers in Europe and the U.S.[1–5]

In light of these puzzling statistics, as well as the recent lung cancer death of Ko Chun-hsiung, a popular movie star turned politician, health officials called for a nationwide screening trial via low-dose CT scans. With widespread screening, of course, there is then the issue of how to deal with the results. Screening can sometimes reveal several smaller lung nodules in otherwise healthy patients. To tackle this pernicious killer, Yao Fong, Head of Thoracic Surgery, and his colleagues turned to the advanced imaging capabilities of a multidisciplinary robotic imaging system. Fong has been a surgeon for almost 30 years and is the first certified attending physician in thoracic surgery in the Tainan area. >

"In the last two or three years, whether due to advances in diagnostics or surgical technology, the local five-year survival rate of lung cancer patients has jumped to over 90 percent now from just above 60 percent in the past, which is a very important advance for us," says Fong. "Of course, a main driver of such progress is the increasing awareness among people of their health. But also, the advances in diagnostic equipment and image-guided surgery."

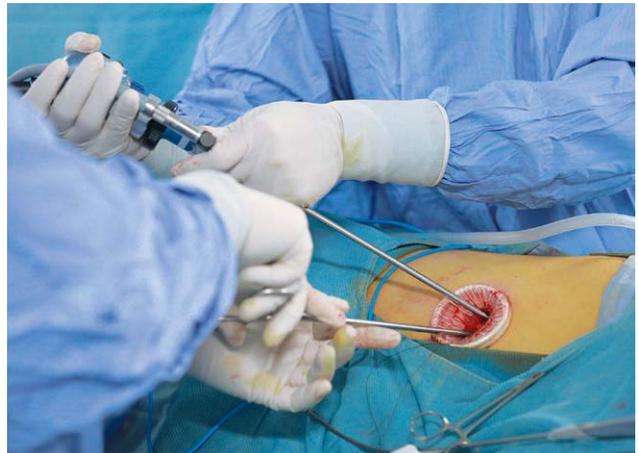
Fong continues: "With the new imaging system, we can start and complete the surgery in the OR safely. These procedures are risky and have a high mortality rate, but now, I believe, our surgeons can successfully overcome the difficulties with more confidence and more assurance."\*

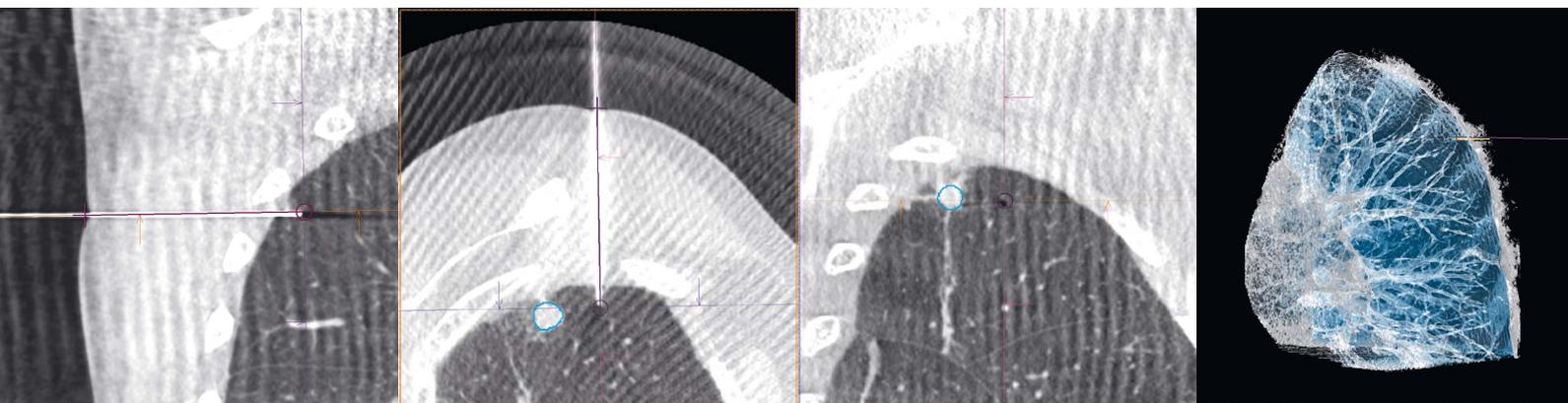
### **Procedural risk in treating small pulmonary nodules**

Lung cancer is not simply a common disease in Taiwan, it is the leading cause of cancer death. "We treat approximately 300 lung cancer cases each year," Fong says. However, the logistical challenges in the past meant increased risks from moving patients: "Scans and tumor marking were performed in the radiology department, where we can't monitor vital signals." Fong explained that patients were given only local anesthesia until they were transferred to a regular OR for the resection of the tumor. "Transport and repositioning of the patient can cause pneumothorax, hemothorax, as well as simply discomfort and anxiety," he adds. Patients also tended to move during the transfer which



Being able to locate small, deep, and thus not-palpable lesions precisely during a surgical intervention is a quantum leap in the treatment of lung cancer.





Defining a needle path to the lesion in different cross-sections with syngo Needle Guidance.

could cause dislocation of the marker. To make up for the loss of accuracy through dislocation, Fong says that physicians had to search manually for nodules, inserting their fingers into the incision and palpating the nodule.

Then came ARTIS pheno, and with it the ability to localize nodules during the intervention without moving the patient. The live imaging brought several advantages: Now, to remove smaller nodules, surgeons at Chi Mei mark the location with dye or solid markers and resect it in the same, safe OR environment. Before, when the procedure was split over two rooms, "marker dyes could fade or smudge," says Yu-Feng Tian, Vice President of Chi Mei Medical Center. "We always needed to rush." And rushing could involve more risk.

### Operational efficiency is key for hospitals

Risk is not the only consideration from an administrative perspective. Healthcare is sometimes a balance between optimal clinical outcomes and cost efficiency. "ARTIS pheno has a much larger C-arm width, providing more freedom and space at the side for patient positioning," says Fong. "We don't have to rely on the localization procedure performed by our radiology department, and we can localize multiple lesions inside the OR. This reduces the costs of transporting patients and moving them between different departments, which is beneficial to the hospital,"\* explains Tian. "This is highly advanced imaging equipment. It helps our surgeons to perform very precise localization of some very small lesions in the OR. There is no doubt that such exact localization

can facilitate surgery and reduce the overall procedure and anesthetic time,"\* he adds. "With this new system, we can see small lesions in the OR in 3D,"\* Fong adds.

### Hospital acquired infections and surgical environments

Infection control is a global challenge in sensitive environments like the OR. According to the World Health Organization, the annual financial losses due to healthcare-associated infections are significant: "They are estimated at approximately € 7 billion in Europe, including direct costs only and reflecting 16 million extra days of hospital stay, and at about US\$ 6.5 billion in the U.S." [1] In a world with rising antibiotic-resistant infections, Chi Mei Medical Center wanted to provide that latest standards for their patients with regards to infection control.

"Since surgery time is reduced, the anesthetic time is shortened, too, and this naturally facilitates the control and prevention of infection to a certain extent," Fong says, describing the connection between surgery time and infection risk. He adds that "the new technology has fewer tubes going outside, so it has a kind of all-in-one structural design. Therefore, it helps to improve the overall cleanliness inside the room. Its microbe-proof performance is much better than the previous generation."\*

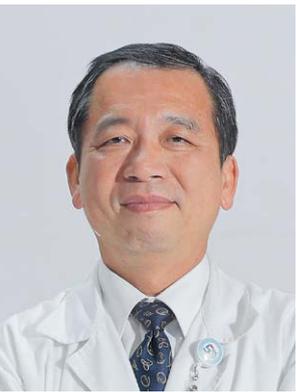
### Impact on the patient experience

As seen with other procedures such as TAVI and EVAR\*\*, the boundaries between disciplines are disappearing. The modern surgeon is aware of classical surgery as well as of interventional



*“I think that such advanced technology allows us to expand its usage to further fields so we can offer more and better options for our patients.”*

**Yao Fong, MD,**  
Director of Thoracic Surgery,  
Chi Mei Medical Center, Tainan, Taiwan



*“Risk is not what you can see, but what you cannot visualize.”*

**Professor Chin-Hong Chang,**  
Director of Neurosurgery,  
Chi Mei Medical Center, Tainan, Taiwan

techniques including imaging. Disciplines work closer together in the hybrid OR where teamwork is key to achieving optimal outcomes. With hybrid ORs, hospitals can now provide procedures that were previously perhaps more invasive or required several different steps. When procedures can be performed with greater speed and safety in one OR, this is not only an advantage in terms of efficiency but also beneficial for the patient.

“With our new system,” explains Fong, “a major benefit is that we can get the patient prepared in time and with only one step: Puncture and then perform the surgery right away. Within about 30 minutes, we can make the incision.

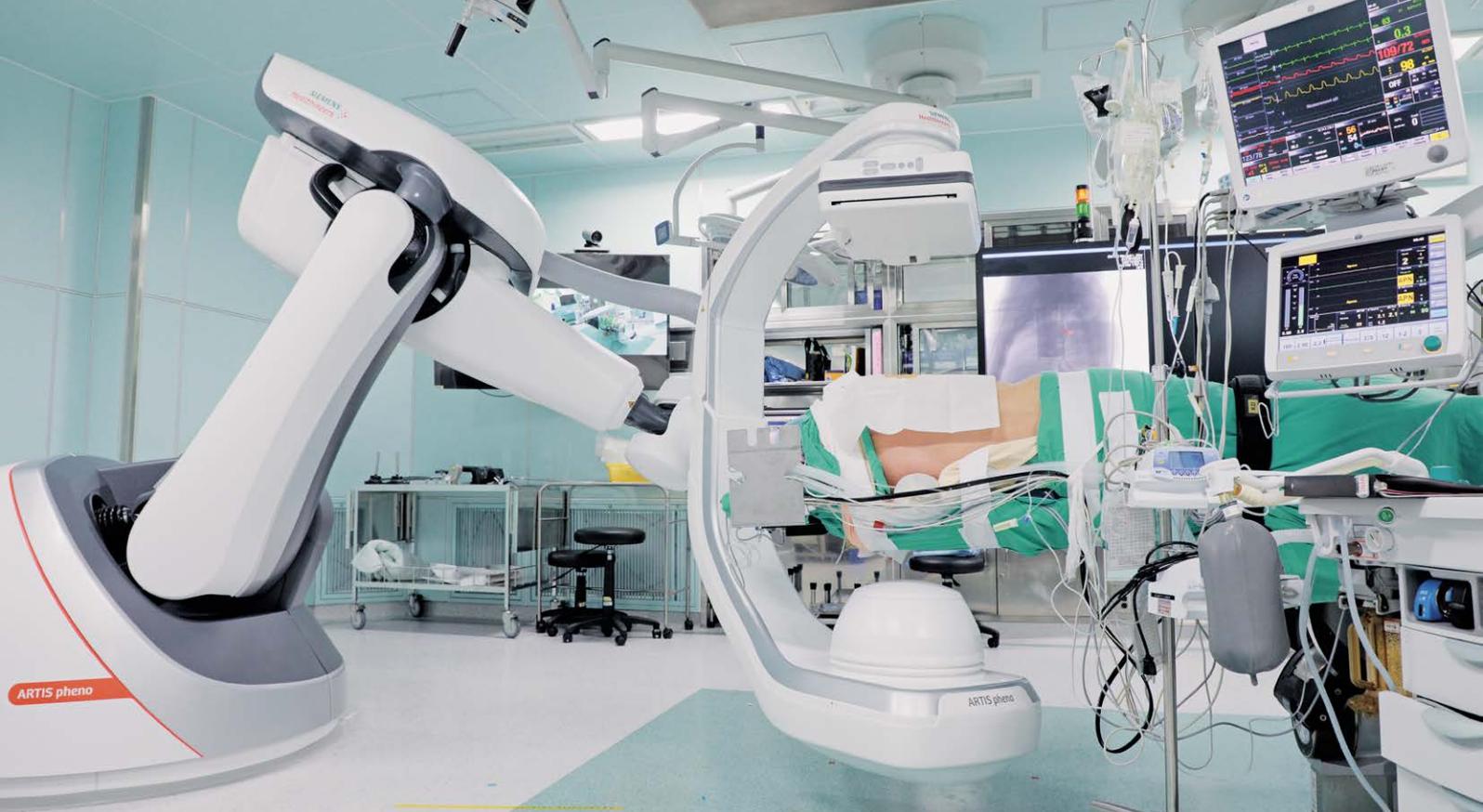
We can anesthetize the patient in advance, which can reduce panic and anxiety and, consequently, risk. So, once the tumor has been marked, we can perform the surgery promptly without any lesion localization problems, such as spread-out or fan-out of the dye. The new system has, in fact, improved our medical performance and is also helpful in terms of the accuracy of our diagnoses and treatments. For the patient, such procedures are truly minimally invasive.”\*

### **New therapeutic approaches**

“With such an advanced system in the operating room we can be much safer.\* Since we installed the new system, we have been able to improve our therapies and develop new approaches. For intraoperative image guidance, we think, that ARTIS pheno is probably the best choice,” summarizes Fong. What is best for patients goes beyond improved clinical outcomes; it’s also about safety, comfort, and reassurance. The future is all about reducing risk, whether through prevention, screening, or the support of advanced imaging to provide life-saving levels of detail. As Chin-Hong Chang, Director of Neurosurgery at Chi Mei Medical Center, explains: “Risk is not what you can see, but what you cannot visualize.” ●

\* 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.

\*\* TAVI: Transcatheter aortic valve implantation;  
EVAR: Endovascular aortic replacement



**Hybrid OR with ARTIS pheno for thoracic surgery and multidisciplinary use at Chi Mei Medical Center.**

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#### Further reading

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# Scaling the Summit of Molecular Imaging

At the recent Molecular Imaging World Summit hosted by Siemens Healthineers, nuclear medicine and molecular imaging professionals were optimistic about the future as they examined trends, research, and technological advancements. The Summit fostered inspired discussion around opportunities for molecular imaging and how the field contributes to the expansion of personalized care.

Text: Bill Hinchberger | Photos: Ronald Patrick

**T**hese are exciting times for molecular imaging and, as current applications broaden, more and more people are benefiting from today's best practices. Moving beyond diagnostics into therapy, molecular imaging propels efforts to provide personalized care that improves patient outcomes. Cutting-edge research in areas like artificial intelligence (AI) suggests that tools, such as digital avatars, will soon become available – even if some seem straight out of science fiction.

Upbeat messages dominated the dialog during the Molecular Imaging World Summit in Lausanne, Switzerland. Hosted by Siemens Healthineers, the conference brought together over 240 participants from more

than 140 institutions around the world. While the mood was generally hopeful, there were a few pauses for reflection around topics such as the possibilities of AI and pressures to adapt to a changing healthcare landscape.

Optimism populated the Summit's keynote address, given by John O. Prior, MD, PhD, FEBNM, professor and head of nuclear medicine and molecular imaging at Centre Hospitalier Universitaire Vaudois (CHUV) in Lausanne, Switzerland. In his opening speech, Prior explained that precision medicine occurs when physicians, "make a treatment plan based on the characteristics of the patient." The concept involves gathering sufficient data about an individual to be able to predict their reaction to a particular treatment,



and to adjust treatment based on results. Continued research is needed regarding the potential of molecular imaging in precision medicine, as there are multiple pathways and possible new tracers that could be “exciting,” he emphasized.

### Quantified precision medicine

Looking to the future, presenters were keen to focus on quantification. Many noted the move from a traditional mixture of qualitative and

subjective analysis to one that relies on quantitative and objective criteria. This approach continues to evolve as both SPECT/CT and PET/CT develop similar quantitative capabilities and analytical tools become more reliable and sophisticated, such as solutions for automated, quantitative SPECT/CT and multiparametric PET.

Quantitative and objective analysis of data are the central motivators behind the increased focus on phenotypes, which is a significant shift from a past where the emphasis was on genotypes. Molecular imaging can help physicians better understand a patient’s phenotype, therefore making it easier to determine whether someone is a good candidate for a certain type of treatment. In the early stages right now, experts anticipate its development over the next decade to strengthen the use of precision medicine.

### Early diagnosis and planning

Presentations on early diagnosis and planning focused to a large extent on opportunities in neurology and orthopedics.

In countries with aging populations demand is growing for hybrid neuroimaging of degenerative diseases, said Jun Hatazawa, MD, Professor of Nuclear Medicine at Osaka University in Japan. Quantitative SPECT/CT improves the neurological diagnosis as it provides biopsy-quality neuropathological results without the need for tissue sampling.

Exploring opportunities in orthopedics, Helmut Rasch, MD, of the Department of Radiology and Nuclear Medicine at Kantonsspital Baselland in Switzerland, explained how everyone dreams of a “one-stop shop”. Biomechanics, metabolism, and morphology all affect the ability to visualize a bone bruise that causes pain, for example. As SPECT/CT offers metabolic and anatomical information in its hybrid approach, it can provide physicians with a wealth of orthopedic information that supports accurate and quick clinical decision-making.

Beyond neurology and orthopedics, a panel of four physicians explored the progression of PET/CT through a review of everyday cases acquired with the Biograph Vision™ PET/CT scanner. The panel vetted the system’s perfor-



Presenters participate in the quantitative imaging panel (top) and Biograph Vision panel (bottom).





The Molecular Imaging World Summit in Lausanne, Switzerland, brought together over 240 participants from more than 140 institutions around the world.

*“The fact that molecular imaging can assess heterogeneity and the dynamics of response and adaptive resistance is a key advantage over other techniques.”*

Olivier Michielin, MD, PhD, Swiss Institute of Bioinformatics

mance, noting the clinical impact they experience with the latest advancements in PET/CT.

### **Therapy management**

As presenters examined the use of molecular imaging in therapy management, the topic centered around prospects for theranostics – the combination of diagnostics and therapy – and immunotherapy.

Treatments considered to have high promise include those designed, “to target a molecular pathway and activate the immune system,” explained Prior. A set of talks on cancer immunotherapy highlighted how understanding the biology of individual patients can help to select those who are most likely to respond favorably

to a particular biomarker, and thus guide first- and second-line therapies. “The fact that molecular imaging can assess heterogeneity and the dynamics of response and adaptive resistance is a key advantage over other techniques,” signaled Olivier Michielin, MD, PhD, Head of the Precision Oncology Center at CHUV and group leader at the Swiss Institute of Bioinformatics. “For me, the future will see a close collaboration between biologists, medical oncologists, and molecular imaging specialists to drive the field forward.”

Precision medicine, theranostics, and dosimetry loomed large in a talk given by Rodney Hicks, MD, Professor of Medicine and Radiology at the University of Melbourne and Director of the Centre for Cancer Imaging at the Peter MacCallum Cancer Centre in Melbourne, Australia. Drawing on the sentiment, “if we can see if, we can



Marcus Hacker, MD, PhD, Medical University of Vienna, speaking about AI in molecular imaging.

## *“AI-assisted software applications are already working on non-small cell lung cancer and lymphoma.”*

Marcus Hacker, MD, PhD, Medical University of Vienna, Austria

“treat it,” he emphasized how personalized data opens the door to tailored dosimetry. In current practice without dosimetry – or a dose-tailored regimen for therapeutic agents – physicians utilize standard protocols even though the treatment option may not help the prognosis for the individual. Dosimetry can support physicians in adapting the therapeutic dose to more effectively treat patients who might be able to withstand a higher dose as well as others who may be excluded as therapy candidates but may benefit from lower-dose protocols. Yet Hicks warned against excessive complexity; when talking about his work with dosimetry he said, “we like to keep it simple.”

Speaking to the implementation of standardized protocols in therapeutics, an invited industry speaker articulated the viewpoint that a stan-

dardized dose regimen for therapeutic agents may accelerate broad adoption by clinicians. From his perspective, topics like dosimetry could be introduced once therapeutics are clinically routine. What followed was an active debate on dosimetry by a panel of international luminaries, moderated by Dale Bailey, PhD, principal physicist in the Department of Nuclear Medicine at Royal North Shore Hospital in Australia.

### **Creating the future of molecular imaging**

Progress in the realm of molecular imaging is likely to be split between important, incremental advances and industry game-changers. Examples of relevant developments ranged from continuous bed motion and motion management

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## Near-future predictions for MI

- The demand for imaging will grow due to aging populations, chronic disease, and reimbursement expansion based on success.
- Due to growing demand more injection rooms will be required.
- The number of available therapies will increase.
- There will be a shift towards predictive imaging.
- Alongside PET/CT and SPECT/CT, PET/MR will be established clinically.
- The number of personnel per patient will decrease.
- AI will aid image acquisition and interpretation.

– Martin A. Walter, MD, PhD  
University Hospital Geneva, Switzerland

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in PET/CT to possibilities for quantitative cardiac SPECT/CT. In his talk, Frederick Giesel, MD, Vice Chair of Nuclear Medicine at the University of Heidelberg, presented the latest results of their work with quinoline-based PET tracers that act as fibroblast activation protein (FAP) inhibitors (FAPis). An emerging diagnostic method, FAPI PET/CT appears to be viable for imaging a broad range of cancers, while providing specific data. Exciting opportunities for a theranostic adjunct also appear to be feasible.

When shifting to game-changers that impact the future of molecular imaging, AI was a salient example. “AI-assisted software applications are already working on non-small cell lung cancer and lymphoma,” said Marcus Hacker, MD, PhD, Head of the Clinical Department of Nuclear Medicine at the Medical University of Vienna.

Experiments seek to apply Google’s face-recognition technology to identify tumors, and machine learning seems capable of differentiating high- and low-risk tumors, as well as malignant and non-malignant ones. The joint future of AI and molecular imaging could include several major developments: the use of predictive biomarkers; convergent molecular diagnostics – a survival-prediction approach that combines molecular diagnostics with molecular imaging – and applied metabiomics.

Even outside the considerations of AI’s impact, it is obvious that the pace of molecular imaging is accelerating: The goal is to gain a clear understanding of disease and utilize this information to better formulate treatment plans that benefit individual patients. When leaders meet again at future world summits, it will be enlightening to see what milestones have been achieved and what remains on the horizon. Yet, regardless of how many predictions we check “accomplished” or not, it is clear there is a crucial place for molecular imaging and nuclear medicine in the future of healthcare, which is cause for great optimism. ●

**Bill Hinchberger** is a Paris-based journalist whose work has appeared in *The Lancet*, *Science*, and many other publications.

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.

Biograph Vision is not commercially available in all countries. Due to regulatory reasons, its future availability cannot be guaranteed. Please contact your local Siemens organization for further details.

# The Impacts of Automated SPECT/CT Quantification on Clinical Workflow

SPECT/CT imaging is a ubiquitous tool that supports clinicians in making prompt diagnoses and developing personalized treatment strategies. With the addition of an automated tool that consistently produces reliable, quantitative measurements, providers explain how they are able to integrate quantification into their routine SPECT/CT protocols.

Text: Claudette Lew | Photo: Alex Teuscher | Illustration: Clint Poy



**S**ilvano Gnesin, PhD, medical physicist at Centre Hospitalier Universitaire Vaudois (CHUV) in Lausanne, Switzerland, discusses ways in which the implementation of automated SPECT/CT quantification impacts his role as a physicist, and how these changes shape the future of therapy management and monitoring with SPECT/CT.

## Has an automated calibration process made it easier to adopt quantitative SPECT/CT at CHUV?

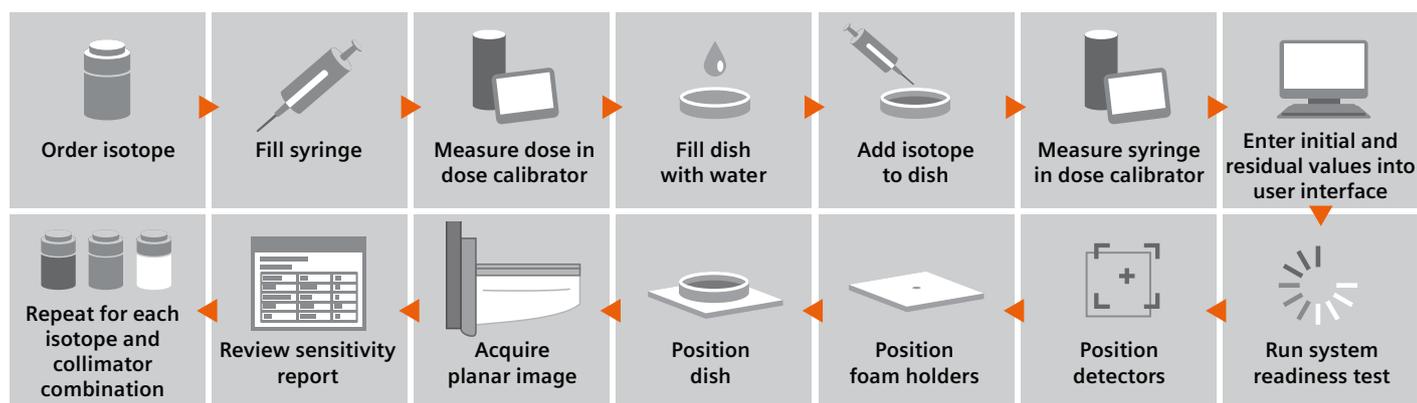
**Silvano Gnesin:** We use quantification on our Symbia Intevo™ SPECT/CT for SUV evaluation, which allows us to assess both the response of disease over time and internal radiation dosimetry. Our automated xSPECT Quant™ tool provides the ability to directly obtain quantitative data from SPECT without performing manual calibrations on the scanner, which means we don't need to verify the calibration of the system each time we want to conduct a quantitative analysis of our data. Previously, it was manual because we had to handle open sources to prepare the phantom for testing, and we had to establish the calibration factors in order to move from proportional counts to quantitative information. Now, with this automated approach, we just have a monthly test with the reference calibration sources (Cobalt-57 and Selenium-75). We do the calibration

every six months because we found the stability of the system is reliable over this range of time, which avoids frequent manipulation of open sources to prepare the phantoms. This is a plus for radiation protection, efficiency, and obtaining quantitative data that can be compared with data from other systems that use the same calibration method. We are able to compare quantitative data across systems because we use sources of calibration that are National Institute of Standards and Technology (NIST) referred, so we are able to have a common standard with others that use the same material.

## How has the implementation of automated SPECT/CT quantification impacted physicists' workload at your facility?

For us, SPECT/CT quantification with xSPECT Quant marked an improvement in our work here. We are pleased to have quantitative data directly from the system to use in dose assessment

## Conventional quantification calibration



⊗ Manual and time intensive – increasing potential for error

## xSPECT Quant™ calibration



of lesions, tumors, and normal tissue. It's a very good way to provide the best treatment plan for each patient. Because the steps are automated, our technologists can do most of the calibration work, and this helps our physicists significantly. Now, the physicist provides an overview of the protocol and the technologist can then install the calibration source and perform the sensitivity measurement, the results of which the physicist checks are in line with the accuracy of the scanner. When we used to perform these calibrations manually, a physicist needed to work at least half a day for just one isotope: Today, it's a matter of one hour. The time our physicists save in the quantification process – because it's standardized and easily performed by the technologists, under our supervision – can now be used to conduct interesting analyses of the data.

For dosimetry we continue the dosimetry protocol by analyzing data, delineating regions of interest, and

deriving the number of disintegration that occur in these regions to then estimate the dose we deliver to the specific tissue. So we are able to correlate quantitative response to a delivered absorbed dose in tissues.

### How do you expect the value of SPECT/CT quantification to increase at CHUV now that it is used in a variety of clinical cases?

What I'm expecting is a full integration of a dosimetry workflow with this quantitative data. That means we can obtain the data from the scanner, easily delineate regions of interest, and measure the number of disintegration in each organ or specific tissue. As a result, we have models to help us move from the number of disintegration to the dose that is delivered to the tissue, helping our clinicians significantly improve the treatment of different types of diseases. We have made SPECT/CT quantification available for most of our clinical cases at CHUV and, in my opinion, our physicians

are more confident using the technology in their clinical routine because of its verified precision and accuracy. This allows us to move toward a vision where SPECT/CT quantification is standard practice. ●

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.



## A Blueprint for an Impactful Patient Experience Program

Effective communication with patients and families, a comfortable diagnostic and testing experience, coordination of care during and between encounters, as well as engagement levels of employees: These are just some of the key factors that influence the patient experience throughout the continuum of care. But which factors are the most important?

Siemens Healthineers and The Beryl Institute conducted a study to identify the most important factors that influence a patient's experience of healthcare.



[siemens-healthineers.com/insights3](https://siemens-healthineers.com/insights3)

## Achieve Twice as Much but Only Work Half as Hard

Zwanger-Pesiri's business model rests on providing radiology services that meet the highest professional standards while also offering superb, personalized customer service.

This paper is co-authored by Bob Day, Chief Operating Officer (COO) of Zwanger-Pesiri Radiology. It consists of a detailed analysis of how Zwanger-Pesiri succeeded in this effort, with personal insights from their senior management and practical examples of best practices and impactful innovations.



[siemens-healthineers.com/insights4](https://siemens-healthineers.com/insights4)



## Five Steps Every Hospital CEO Should Start Today

Hospital executives hold the key to unlocking the value of reducing unwarranted variations. They are an indispensable part of the communities they serve, so it is imperative that hospital executives continue the hard work of cutting waste while improving quality. In this paper, Brent James states that 25 percent of hospital costs are waste from unwarranted variations. How can hospital executives eliminate those variations?



[siemens-healthineers.com/insights1](https://siemens-healthineers.com/insights1)



Breast cancer is impacting **2.1 million women** each year<sup>1</sup>

## Reducing Fear and Anxiety by Redesigning the Patient Experience

Faster results, quicker care for those who need it, and less anxiety for all patients – the team at the Baylor Clinic, led by Emily Sedgwick, MD, set out to design an improved and more effective patient experience in breast care. Their mission was to redesign their diagnostic procedures in order to offer all patients a better diagnostic experience and ultimately better patient outcomes.

<sup>1</sup>Source: World Health Organization



[siemens-healthineers.com/insights5](https://www.siemens-healthineers.com/insights5)

## Standardization and Personalization: Lessons from Other Industries

Hospital executives can deliver high-value care and reduce costs by effectively managing variations – reducing unwanted variations, and enhancing desirable variations. Together with Prof. Michael T. Modic, we identify important lessons by assessing the manufacturing and retail industries, as well as other digitalization-enabled industries. Proven and practical recommendations can help healthcare organizations to lead the change to greater standardization together with more effective personalization.



[siemens-healthineers.com/insights6](https://www.siemens-healthineers.com/insights6)



## Culture of Diversity, Respect, and Inclusion

To deliver outcomes that matter to patients and reduce costs for everyone involved, hospital executives need committed and productive employees. Staff diversity can stimulate creativity and innovation, and enable value-added solutions for patients. This paper is designed to help other healthcare leaders envision and implement their own team-based care and create positive workplaces in the future.



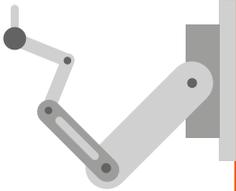
[siemens-healthineers.com/insights2](https://www.siemens-healthineers.com/insights2)

# Facts and Figures from Around the World

## Innovation & Digitalization

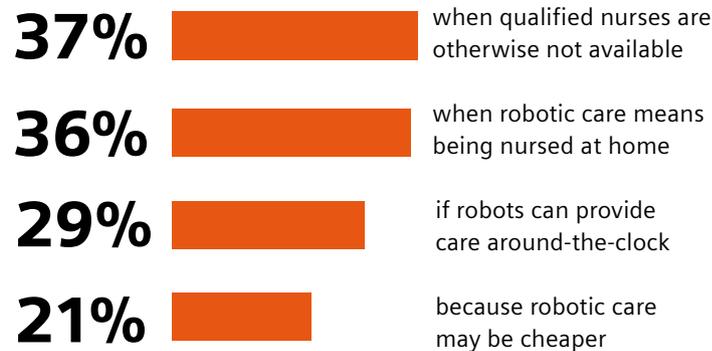
**77%**

of Germans would consider being operated on by a robot.



### Robots in Healthcare

#### What patients say



[1]

**56%**

Germans would consider being nursed by a robot in their old age.



### Digital Prescriptions



In Estonia, 85% of doctors' drug prescriptions are issued digitally, not on paper, and can be redeemed in any pharmacy.

[2]

### Wearables

**20%**

of the Americas market share for wearables was in South America in 2016. The adoption of wearable medical technology and homecare devices is increasing rapidly.



[3]

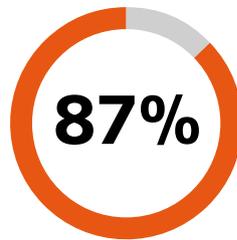
**eHealth**



of Member States have an eHealth strategy



of countries have legislation to protect electronic patient data



of countries report having one or more national initiatives

[4]

**Homecare**

**US\$ 507 million**

in value represented by home monitoring platforms and home care services in Asia in 2018. Digital platforms will drive 20% growth in the clinical trials market.

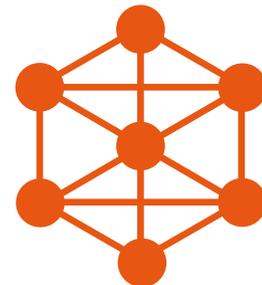
[5]



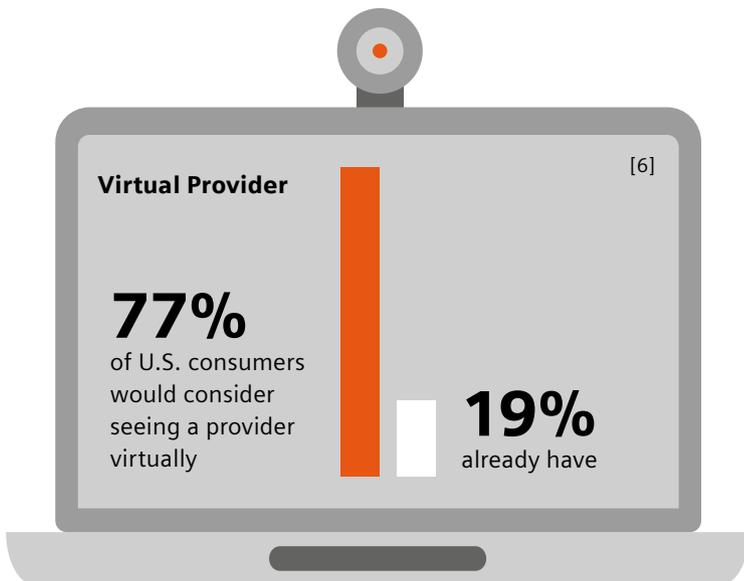
**Networked Devices**

**147.7 million devices**

were projected to be networked in South Africa by 2018. The country has made great strides in technology, ranking second in the sub-Saharan Africa region on the Network Readiness Index.



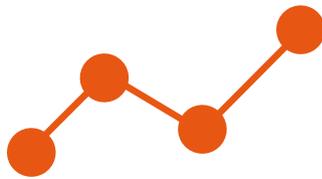
[7]



**Telehealth**

**28.7 million**

Paid by Medicare in 2016 for telehealth services in the U.S.



**22.4 million**

in 2015 – equaling a 28% increase

[8]

**Record Investment**



**US\$ 5.8 billion**

was invested in U.S. Digital Health companies in 2017.

[9]

**Unprotected Data**

More than

**5 million patient records**

in the U.S. and millions more around the world are unprotected on the internet, including X-rays, MRIs, and CT scans, available to anyone with basic computer expertise.



[10]

**Personal Data**



More than

**16 million scans**

with medical data worldwide are available online, including names, birthdates, and, in some cases, social security numbers.

[11]

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