Troponin Assays

Why the introduction of high-sensitivity troponin assays is so important

### **Remote Testing**

How far point-of-care testing in Australia's Outback has come

#### **Student Voices**

What kinds of collaborations the future will bring

### **Artificial Intelligence**

How AI is set to become an essential tool for all medical specialities

## Medical Solutions

The Magazine for Healthcare Leadership

## The Big Data Picture

Professor Rossa Chiu: Painting a more comprehensive picture of the patient with laboratory diagnostics



### Speaking of collaboration ...

"Collaboration is key to improving the quality of healthcare delivery and furthering medical research. By designing advanced systems that compile unprecedented amounts of data and enable healthcare providers to access and share it, we are fostering wholly new ways to collaborate. The goal: To make every piece of information that is relevant to a physician's decision-making and a patient's well-being rapidly and reliably available."

Dr. Bernd Montag, Chief Executive Officer, Siemens Healthineers

## Designing Advanced Tools to Power Collaboration in Healthcare

Collaboration, the theme of our latest issue, has long been at the heart of healthcare. Today, technological advances are expanding and even redefining the nature of healthcare collaboration.

Telemedicine enables medical experts on different sides of the planet to collaborate, of course. But that's just the beginning. Advanced systems can now connect doctors, labs, pharmacies, and virtually every department in a medical center, sharing information with unprecedented speed and accuracy. Medical databases, combined with AI, make it possible for clinicians to tap knowledge gleaned from researchers in genomics, proteomics, molecular medicine, and an array of other fields – a new form of collaboration that is the cornerstone of precision medicine. Secure communication systems, personal apps, and even wearable devices will foster unprecedented collaboration between physician and patient, the foundation of preventive care and community medicine.

You'll find plenty of examples in these pages of innovative technologies that are redefining collaboration in healthcare. In our cover story (p. 8), clinical chemist Professor Rossa Chiu describes how tools to analyze big data give clinicians access to genetic information that will transform cancer therapy. And for a moving account of the way advances in healthcare delivery can affect individual lives, read our feature on point-of-care diabetes testing (p. 20).





### **Thought Leadership**

### **Laboratory Diagnostics**

Rossa Chiu, Professor of Clinical Pathology at the Chinese University of Hong Kong, tells us about the importance of data analytics in the future of diagnostic medicine.

### Speaking of collaboration ...



"Queensland's Outback point-of-care system impressed and surprised me. A decade of investment in collaboration between professionals, managers, and thousands of trained remote staff is saving lives once sadly neglected. Inspiring!" (p. 14)

**Garry Barker,** journalist in Melbourne



"What impresses in clinical laboratories is the continuous endeavor to reevaluate and upgrade tests and programs to meet the ever-increasing demand for more testing, faster turnaround times, and to enhance patient care with fewer resources." (p. 40)

**Linda Brookes,** medical writer in New York City



"What will the advent of AI mean for medical specialities? In my opinion, this is the most interesting question raised by artificial intelligence. Will we finally enter an age of despecialization and interdisciplinarity? Too early to say, but interesting to watch." (p. 30)

Philipp Grätzel von Grätz, healthcare journalist in Berlin

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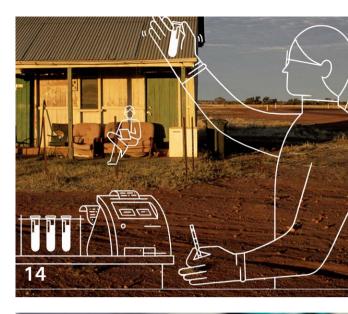
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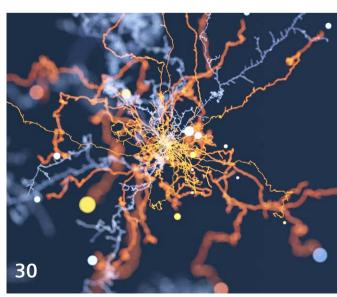
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Better collaboration between **clinical and laboratory staff** may lead to a significant reduction of delays through a continuous improvement of processes. From the patient's point of view, the conversion of data into useful information is the only thing that counts.





Improved

## Collaboration

for Better Patient Care

Infographic: Jens Amende | Text: Roman Elsener

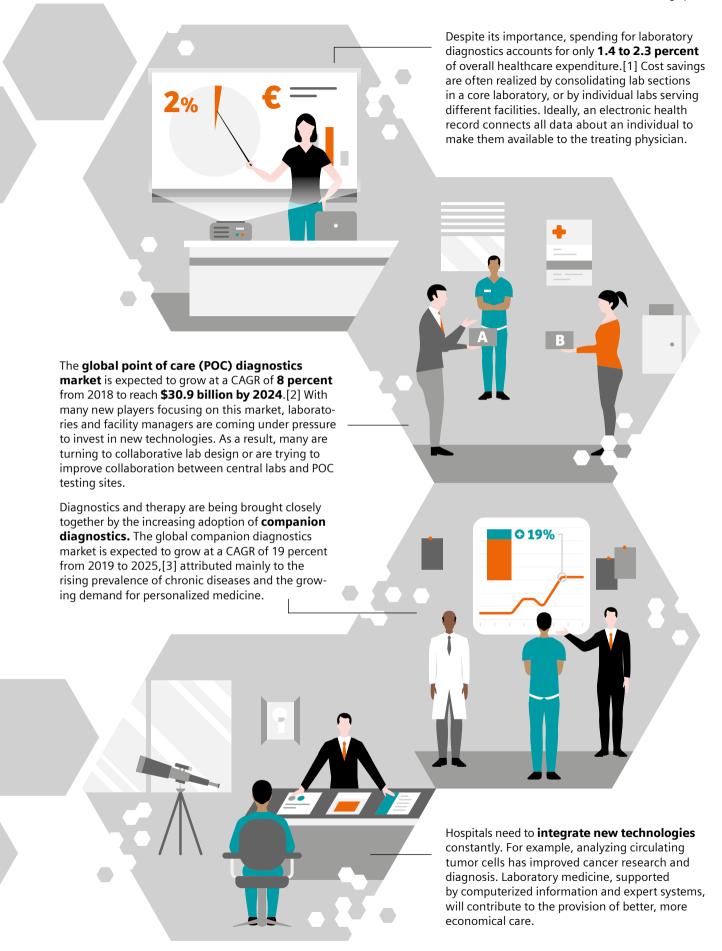
**Diagnostics** have moved far beyond the hospital. Together with data generated in clinics, information on the patient's lifestyle is becoming increasingly important. By collecting data intelligently, medical wearables are providing added value to healthcare.

Without access to laboratory diagnostics, health providers cannot **diagnose patients effectively and promptly, or provide appropriate treatments.** The WHO has therefore established a Strategic Advisory Group of Experts on In Vitro Diagnostics (SAGE IVD) for matters of global policies related to in vitro diagnostics (IVD). One of its first objectives is to make recommendations on the development of a model list of essential IVDs.



- [1] https://www.aacc.org/health-and-science-policy/aacc-policy-reports/2015/laboratory-medicine-advancing-quality-in-patient-care
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Personalized medicine, big data, and enhanced communication between disciplines all contribute to a more comprehensive picture of the patient. These trends are well under way, and they will have far reaching consequences for patients, doctors, and clinical work, says **Professor Rossa Chiu**, one of the world's foremost experts on plasma-based diagnostic research.

# The Big Picture in Laboratory Diagnostics

Interview: Justus Krüger | Photos: Hans Sautter



s a leading clinical chemist, you develop new diagnostic tools, for example for cancer. Several new, comprehensive developments in clinical work converge in your research. This emphasis on convergence – has it always been a part of your outlook?

I have always been fascinated by diagnostic medicine. I became extremely interested in data analysis as early as medical school – the process a doctor goes through when trying to get the evidence and work out the diagnosis for a patient. Biochemistry, physiology, and pathology were at the center of my interest, but even more so the combination of all this knowledge. Because, unlike in a textbook, a patient who needs an initial diagnosis won't come in and say, "Hey, I'm a classic textbook case of diabetes." My interest has always been the process by which we reverse-deduce what is happening with the patient. You start with the clues.

## Utilizing big data is one of the defining trends in clinical work. What role does it play? Could you give an example?

Let's talk about detecting a cancer signature in the blood circulation of a patient. We know that when a tumor or cancer develops, a proportion of its cells will die and release DNA material into the person's circulation. Immediately you are confronted with an analytical and statistical problem. That is, can we take a blood sample from a person and look into the fragments of DNA that are floating around in it and see any signs of cancer development?

But instead of detecting cancer signatures in the blood circulation of patients who have large tumors, our research group wanted to see if it's at all possible to detect the tiniest glimpse of cancer DNA in a person's circulation even when they don't know that there might be a small tumor already developing. The aim is to develop blood tests that will be useful in detecting and locating early cancers.

Rossa Chiu paints a bigger picture of the collaboration between the different diagnostic and therapeutic specialties.



In such a scenario, less than one percent of the DNA in the blood sample would come from the cancer. We're trying to find a needle in a haystack – and very often that needle looks very similar to the hay. So, big data analysis is part and parcel of the diagnostic tests that my research group is trying to develop.

### Could you elaborate on the role of big data in this context?

When you have applications where you look for small abnormalities in the genome, this can require the analysis of billions of DNA molecules per blood sample. So there is a statistical problem in the sense that I have to analyze many DNA molecules in order to have a hope of picking up that one abnormal alphabet. In addition, if I pick it up, I have to be sure that it's not an analytical error. Which is why we have to use the best wet laboratory analytical tools and combine them with very sophisticated computational algorithms. This is to make sure that, among all the data the laboratory equipment is generating, the computer algorithm can identify the disease signature. What we have here is a combination of sophisticated lab techniques with sophisticated bioinformatics algorithms. It also means that we take in information from different clinicians, lifestyle information from the patients, and any other information that is relevant to the matter at hand.

### Maximizing the extent to which data can be combined and analyzed – what does this mean for different disciplines cooperating in the hospital?

One important aspect is infrastructure, meaning the capacity of hospitals and laboratories to process and store data and make it accessible to the clinicians who can utilize it. This will definitely need to be enhanced. A part of this infrastructure revolves around the question of how to guarantee data security. Some hospitals are still wary of using the cloud to store data. Having a virtual storage place feels less secure than having a physical one, although this is not necessarily the case. So I think there will be significant changes in the infrastructure of hospitals.

This is a field where diagnostic companies can be of assistance. I expect, for example, that the analyzers we are using will have better data storage capacity and better connectivity in the future. Also, in order to collect lifestyle information from patients, we need devices that are handy, useful, and work seamlessly while the patients carry on with their daily lives.

Another aspect that is quite crucial would be "communicability." That is, whether data from imaging and data from a biochemistry analyzer, for example, can be combined seamlessly. So the cross-communication between different systems, the language itself, the actual matrix, the algorithms – all these need to work together.

On another note, if we can utilize data to adopt preventive medicine, I hope we will increasingly be able to keep patients out of hospitals. So hopefully a lot of healthcare would happen in the community rather than in the hospital.

**Rossa Chiu, PhD,** is Professor of Chemical Pathology and Associate Dean (Development) of the Faculty of Medicine at the Chinese University of Hong Kong.

The analysis of circulating nucleic acids found in human plasma and plasma-based diagnostics is Professor Chiu's main research interest, with a particular focus on maximizing the extraction of pathological information from each sample. By pushing the sensitivity of tests to get more clinical information from chromosomal abnormalities, tissue mapping, and other signals, she hopes to lay the foundation for cost-effective and accessible tests for early cancer detection.

Professor Chiu emphasizes the importance of focusing on better diagnostics. Several major cancers are usually detected in later stages, but proactive screening and earlier detection could mean better understanding of cancer behaviors and lifesaving progress in cancer treatment.

Professor Chiu, who has won numerous international awards for her research and holds over 150 patents, graduated from medical school at the University of Queensland, Australia, and was awarded a Doctor of Philosophy by The Chinese University of Hong Kong. She is a Fellow of the Royal College of Pathologists of Australasia, the Hong Kong College of Pathologists, and the Hong Kong Academy of Medicine (Pathology).

### Speaking of collaboration ...

"Different clinicians need to agree on what forms of data to collect, while also developing the same attitude about accurately collecting data. All the medical disciplines need to be able to connect their data so that the different information systems are able to communicate. We need to work on the infrastructure to make this possible, and the diagnostic companies need to make sure that there is a sufficient level of connectivity between the different systems, the language itself, the actual matrix, the algorithms – all these need to work together."

Rossa Chiu, Professor of Chemical Pathology

### Do you think that such an approach to medicine may somewhat shift the emphasis from therapy to prevention and diagnostics, perhaps with implications for funding priorities and expenditures?

It is in the nature of the research that therapeutic developments usually require more funding than diagnostic research, and this is of course understandable. Developing new drugs is so costly that pharmaceutical companies are aware of the benefits of companion diagnostics, that is, tests that might help a clinician to identify what is the most suitable target group for a particular drug. The companies have also realized the potential of patient testing to help them reduce the cost of drug development. So instead of having diagnostic research and therapeutic research competing against each other, they are actually complementary.

In addition, if we can develop tests to detect cancer early, then the treatments that are already available will be more effective.

Apart from data generated in the clinic, additional information, for example on the patient's lifestyle, is becoming increasingly important. This brings us to another major trend in clinical work: more personalized medicine. How does this overlap with the clinical tools that you have just described? Let me give you an example: When we look for a rare event such as cancer in a largely healthy population, the chance of detecting a false positive can be higher than detecting a real positive. In order to reverse the odds, we use big data to combine the genetic information generated in the lab with non-genetic information such as demographic profiles and lifestyle information. This enables us to determine the likelihood of that person having a disease or not if we have tested them positive – and the more the indicators overlap, the higher the probability.

Or let's say we are developing a way to monitor a person's treatment efficacy for diabetes. It would be helpful to know what the person has eaten that day, what is the distribution of nutrients, as well as the person's exercise level, and so on. It would be better if we could get that sort of information over a long period of time. And it would be even better if we knew the patient's family history...

### You could extend that almost indefinitely, right?

Exactly. Now imagine there were ways to accurately collect all such data. If we were to combine this information with measurements of the blood glucose level of the person in question, then we might be able to provide a better treatment regimen – instead of saying: Everybody who has a blood glucose level of eight, or what we call an HBA1c level of eight percent, gets the same treatment. This move to increasing personalization is what is happening right now.

This is how we foresee diagnostic medicine developing. We won't use a one-size-fits-all approach. Instead, we need to combine the clinical information with personal data to find the best treatment to fit an individual's profile. That is the future.

So the trend is going toward hospitals reproducing what a good GP in a small town can do – a doctor who has personally known each patient and their families for a long time. You could say so. Such a GP might see that an old friend developed a limp. He knows that he shouldn't be limping in this way and might conclude that his friend could have had a stroke – because he knows the person. In a hospital, this is a challenge, because a lot of the patients



"If we can utilize data to adopt preventive medicine, I hope we will increasingly be able to keep patients out of hospitals. So hopefully a lot of healthcare would happen in the community rather than in the hospital."

Professor Rossa Chiu

coming in, we know nothing about them. In addition, they might be unconscious. Collecting and combining data in the manner I just described helps us to see the bigger picture.

### With the bigger picture comes a whole new scenario...

Yes. We also need to talk about the impact on the patients, who can suddenly play a more active role in their own healthcare. One question is: Will they agree to have their lifestyle information collected? If they do, then I believe that they will increasingly develop a sense of control over their healthcare. It may also afford patients more flexibility. Let's say we have a case of diabetes that requires fairly aggressive treatment. Currently, the patient can only listen to the doctor's

advice and will have to stick to a stable health regime – medication, exercise, diet.

But in the future, the same patient could have devices that monitor his or her health indices. This might afford him or her more flexibility. The system might say, "Hey, actually you've exercised a lot, your blood sugar level right now is doing quite well. You can be a little bit relaxed with this particular meal." Some patients may find this liberating, and it will certainly enable us to go further into preventive medicine. Other patients, though, may find this unpleasant – they may feel there is too much monitoring and feedback. I believe we will have different reactions to any healthcare modalities that will evolve in the future. In the end, people will always be people.

Based in Hong Kong, independent journalist Justus Krüger is a frequent contributor to Stern, Berliner Zeitung, Spiegel, NZZ, and many other publications.

## Digitalizing Care in the Outback

Few nations are as developed as Australia when it comes to providing medical testing services to remote communities. But while point-of-care testing for diabetes and urinary diseases among rural and remote Aboriginal communities has long been available nationally, centrally digitalized and managed systems are more recent developments.

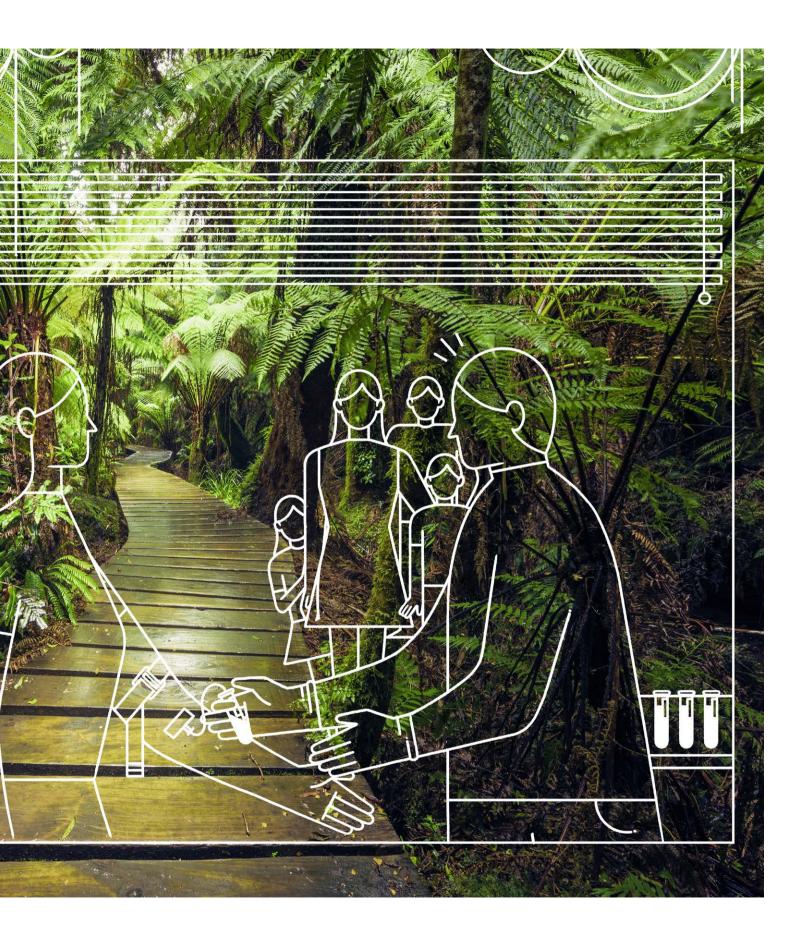
Text: Garry Barker | Photos: George Clerk/Getty Images, Andrea Robinson/Getty Images | Illustrations: Patricia Tarczynski

magine a pathology clinic bigger than Texas, covering 1,730,648 square kilometers (668,207 square miles) with 10,000 trained analyzer operators serving two million potential patients living in areas varying from modern cities to the humid depths of tropical rain forests and barren baking deserts where temperatures rise through 50 degrees Celsius (122°F). Such is the scope and spread of the Australian state of Queensland's point-of-care testing (POCT) system, run by the Health Department – all interconnected by a web of fiber optic cable, microwave radio, and satellite transmissions, and managed by an expert team of three based in the Royal Brisbane Hospital.

### Geographical challenges...

The system, led by Point-of-Care Coordinator Cameron Martin, handled 440,000 tests in 2018, with the load expected to be even greater this year. The vast areas of Queensland and the needs of small communities hundreds of kilometers from the bigger coastal towns and cities





present special challenges. "We have rain forest and desert, and each has its unique diseases and disorders," Martin explained. The service has analyzers at work as far away as Birdsville, 1,600 kilometers (994 miles) west of the state capital Brisbane and one of the most remote places in Australia. It's so hot in summer you can fry an egg on an asphalt roadway in seconds. "50 plus degrees Celsius in the shade is too hot for accuracy from the analyzers but we have air-conditioning in the medical centers," Martin said. "Each indigenous community up in Cape York, on Queensland's northern-most tip, has a health center and we have at least one analyzer in all of them," he said. "The service covers the whole state, all the way up to the Papua New Guinea border and the Torres Strait Islands."

### ...and seasonal trials

Distance and remoteness, the great Australian challenges, have been conquered by the system but there are seasonal trials: fierce cyclones and flooding, recently unprecedented and disastrous around Cairns in the state's north. "It is not often that we have a problem with that," Martin said, "but if we have to get resources to areas suffering damage we have the State Emergency Service's helicopters and boats to help." In the far north it is normal that the only way to reach some communities in the wet season is by air.

"Our connection to even quite remote medical centers is by fiber optic cable with microwave radio and a bit of satellite when the medical center is really remote. Queensland Health did a great job of re-cabling the state a few years ago from copper to fiber. They did it for a telemedicine program that includes online training, which works very well, and we piggybacked on that," he said.

### Training and accountability

When trainees complete their course, Martin's control center is sent the details of their identity and their training which then goes into the middleware system, the Siemens Healthineers POCcelerator Data Management System. "Operators who are not completing their tests correctly receive three warnings through the email system, derived from reports from POCcelerator, and if they ignore them they find their enrolment is shortened and they are forced to repeat the training program. It's a fantastic tool because we're managing operators by exception rather than

blindly targeting everyone. We can push the details out to the individual analyzer as needed and ensure that only people who have been trained are doing the tests," Martin said. "If there are any issues, we can always track back to the source of the test, the analyzer, and its user to check which operators are current and which are not. We always know who did the test."

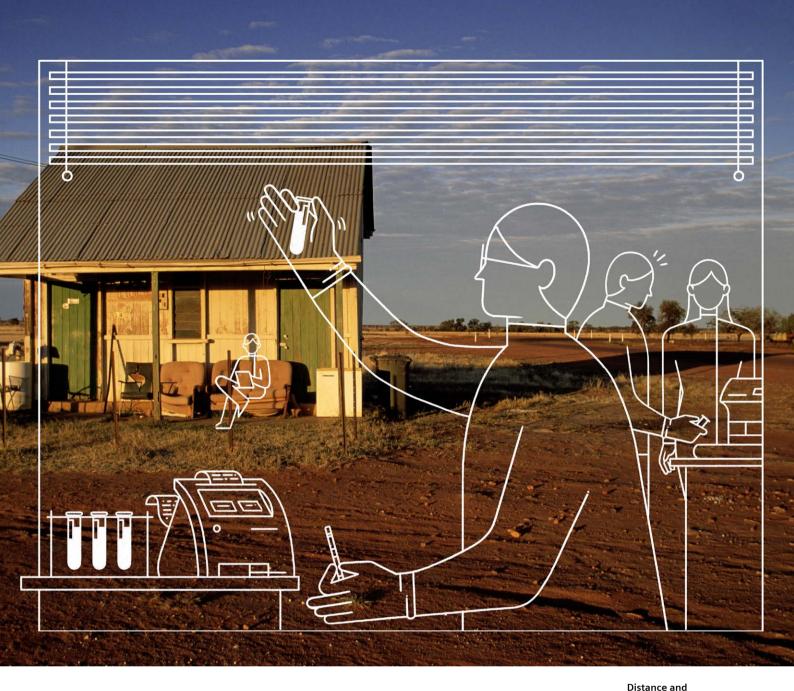
Recruitment, training, and registration of the huge and constantly changing cohort of analyzer users is an ongoing effort due to the transient nature of people working in the Outback. This also means track must be kept of analyzers and other equipment which might be lost or misplaced.

The service has more than 190 sites each with at least one analyzer at the moment and in total more than 300 analyzers of various types and from a variety of manufacturers – with the number continuing to grow. More and better tests are becoming available all the time along with updates to analyzers and new devices and the service maintains a close eye on those developments, Martin said. "We work with 35 Pathology Queensland labs, all up the east coast and a number dotting the interior in larger places such as Mount Isa and Longreach. Lab scientists are a close-knit group," he said, "and we all know one another."

### Informed decisions on site

Testing and retrieval of the results is far faster than the traditional way of transporting a blood sample to a pathology lab and waiting for the result to be returned to the doctor. "We can get the result from a test, usually done with a fingerprick and an analyzer, in two to ten minutes, depending on the test," he said. "Then, not only do we know the result but we know who the patient was, where they were, and who did the test. Staff at the test site also have the result and they are connected to the statewide pathology system so the doctors on site can make the decision to treat their patient on the spot or evacuate them to a larger facility, either by road or by the Flying Doctor Service."

According to Martin, the system gives remote medical staff the tools to make more informed decisions on who stays and who goes. "That means we are making the best use of the transport services we have and also making the best decision for patients."



### A growing variety of exams

Remote area medical centers in Australia deal with a wide variety of problems ranging from diseases such as the endemic diabetes suffered mainly by Aboriginal people to heart attacks and most of the maladies encountered in big city practices, but with the added difficulties imposed by their remoteness.

The point-of-care analyzers deal with the testing and diagnosis end of the medical equation. "We can test for chest pains, and check whether patients are having a heart attack," Martin said. "Chest pain is a biggie on our list. It's not the most common test we do, but you certainly need to know as soon as possible if it is really a heart

attack or just a muscle strain or indigestion. We can also test for renal problems and we have other analyzers that can look for sepsis." He even expects that at some point in the future a device could be developed to test for the squamous cells of skin cancer, of which Australia with its intense sunlight has the world's highest rate.

"Electrolytes and urea are common screens.
Blood gases (oxygen and carbon dioxide) make
up a big part of our screening because they can
be suggestive of various disorders. And it's not
just acute diagnostic stuff. These analyzers can
do INR tests, monitoring people on blood thinners so they don't get overdoses. It's particularly
common up in Cape York where a lot of people

remoteness: Two challenges the Australian healthcare system faces. are on it because of damage from rheumatic fever. Patients get their readouts, their treatment, and their help on the spot in one visit."

### Time and cost savings

"Over the past 15 or so years, these devices have become more portable, more reliable, and more accurate and that improvement is continuing," Martin said. At the same time, the technology for managing all the data has become more sophisticated. Such has been the improvement that today results from these devices in the field rival in quality those done in laboratories.

Since installing the POCcelerator Data Management System, Queensland Health has also achieved significant economic benefits, including a five percent increase in cost recovery through reimbursements. At the same time, said Martin, he and his staff had gained a full eight hours a week of coordinator time.

**Garry Barker** specializes in business, technology, and healthcare. Previously Technology Editor of *The Age*, Melbourne's premier morning newspaper, he now writes and produces weekly global podcasts on those topics.

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- [6] https://www.cadth.ca/sites/default/files/pdf/es0308\_ point of care testing.pdf.

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.

# Reaching Out with POCT Globally: Other Remote Areas

Just as different countries with remoteness areas face different challenges, point-of-care testing is more or less advanced across the globe. A brief look at the situation in India, South Africa, and Canada.



Based on research by Swati Prasad in Delhi, Janine Stephen in Cape Town, and Roman Elsener in New York

### Canada

The use of POCT has been growing in Canada in recent years and is expected to greatly expand in the future, according to a recent report by the Canadian Agency for Drugs and Technologies in Health, a national healthcare advisory organization set up by Canada's federal, provincial, and territorial governments.[6] The report noted that there are still some challenges associated with POCT, mainly related to quality assurance.

POCT is performed by clinical staff rather than lab-trained individuals, which can lead to errors resulting from a lack of understanding of the importance of quality control and quality assurance practices. POCT thus requires a significant amount of support from a central laboratory to ensure quality testing and to meet accreditation requirements.

The report further discusses implications for the healthcare system of wider POCT adoption. It saw the need to address a range of regulatory, organizational, and technological considerations to ensure that POCT is performed under predictable, efficient, and integrated conditions and according to the highest standards of quality. Ways to improve quality control include documentation of POCT orders, charting of POCT results, as well as training and certification of individuals performing POCT. It is also recommended to implement connectivity between POCT instruments and electronic medical records. Meanwhile, the Canadian Primary Care Sentinel Surveillance Network currently connects with about 1,000 primary care sites across Canada, including the Northwest Territories, and generates data on usage patterns and disease prevalence in those areas.

### India

For India's 1.33 billion population, remoteness is less about human habitation than about access to basic services: healthcare, roads, sanitation, and utilities such as power and high-speed internet. Healthcare is concentrated in urban areas where 60 percent of hospitals, 75 percent of dispensaries, and 80 percent of doctors reach only 28 percent of the Indian population, according to a recent report by the Organisation of Pharmaceutical Producers of India and KPMG.[1]

Yet, digitalization of healthcare services is growing. India's telemedicine sector is expected to double from US\$ 15 million in 2016 to US\$ 32 million by 2020.[2] But a large problem remains: Government spending on free public healthcare amounts to only one percent of GDP; 65 percent of health expenditure is out-of-pocket, pushing 57 million people into poverty each year.[3] Nationally, there is only one government doctor for every 10,189 people, one tenth of the WHO recommendation.

The U.S.-based Center for Disease Dynamics, Economics & Policy (CDDEP) recently reported that India needs 600,000 more doctors and two million more nurses. The situation is exacerbated by severe infrastructure problems. In 2015, about 35 million people in hinterlands relied on local public health centers that had no electricity supply.[4] But where telemedicine infrastructure exists, 76 percent of patients can get medical care in their village.[5] The potential for point-of-care digitalized medical services is immense.

### **South Africa**

In South Africa, more than 7.2 million people live with HIV/AIDS, while other illnesses such as diabetes and tuberculosis also burden the healthcare system. South Africa runs the world's largest HIV treatment program, with UNAIDS estimating that 61 percent of HIV-positive people are on antiretroviral therapy. Expanding POCT systems and speeding up test results delivery is helping to provide quality care. Treatment models in South Africa often rely on community healthcare workers and clinics, sometimes in remote areas. The CD4 white blood cell count is an important marker of disease progression and a proposed "tiered" service delivery model aims to give remote frontline health workers more rapid access to these (and other) test results.

South Africa's National Health Laboratory Service is piloting and rolling out "mini-laboratories" to service local clinics, as well as, with the Department of Health, POCT sites in hard-toreach areas. Ideally, the smallest Tier 1 and 2 sites will use a variety of POCT devices to cut reporting turnaround times. Research by an expert group from the University of the Witwatersrand concluded that Tier 3 community laboratories could provide quality of CD4 testing comparable to large laboratories. A Tier 3 lab in De Aar, servicing a remote Karoo area, cut CD4 results turnaround times from an average of 20 hours to eight. The remote sites have SMS printers to provide rapid results for tests including HIV viral load, CD4, tuberculosis, and cryptococcal screening.

The South African National Health Laboratory Service's central data warehouse also stores, manages, and analyses all laboratory information system data from tests generated in the country. This helps monitor laboratory performance and turnaround time for the top 25 tests, including HIV and tuberculosis.



## Taking Diabetes Testing to the Next Level

Globally, the prevalence of diabetes has increased dramatically; the number of adults with the disease has almost doubled in the last 30 years. Diabetes affects 422 million people worldwide (or one person in 11) and is responsible for 1.5 million deaths each year. If not treated properly, diabetes can lead to serious health consequences, especially due to its effects on the cardiovascular system or peripheral organs such as the kidney.

Text: Diana Smith



You do not have to go to a hospital for diabetes testing it can be done while doing your chores - just like at this market on the US-Mexican border.

> eople living in areas with few resources, including medical provision, face dire risks from undiagnosed diabetes. Yet, a new collaboration has emerged to help fight this deadly disease. Rapid point-of-care (POC) testing allows detection of diabetes at any location in mere minutes. With reliable diagnostic results, intervention and care can be provided to improve health and save lives, avoiding associated economic harm.

### Fatal consequences lead to global crisis

Diabetes is one of the main causes of patients developing gradual loss of kidney function over time, known as chronic kidney disease (CKD). As a whole, CKD affects 10 percent of the global population, and is the cause of an estimated five to 10 million deaths each year.

The human and economic tolls are immense; patients with CKD face diminished quality of life, higher risk of other health problems, and significant financial costs, or even death. By the time symptoms appear, kidney function is already significantly impaired. If not treated properly, CKD leads to kidney failure, known as end-stage renal disease (ESRD).

There is no cure for chronic kidney disease. Yet, if detected early, treatment can help slow or halt the progression of the disease and other serious complications. Simple laboratory or POC tests that detect CKD may be the solution for many patients.

POC testing, along with awareness and management of risk factors, provides hope in reducing the devastating effects in highrisk groups, such as diabetes patients, before irreversible damage or other complications occur. Blood monitoring systems provide for regular blood and glucose analysis in the field. Moreover, analyzers that perform glycosylated hemoglobin (HbA1c) tests for diabetes and microalbumin tests to measure albumin levels in the urine (an early indicator of kidney disease) in about one minute show promise, particularly for medically underserved areas around the globe.

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### Diabetes on the rise

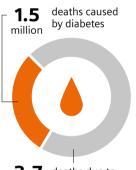
Number of people with diabetes worldwide

2017

(2045)

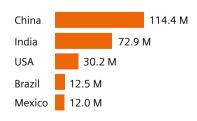
Today that's 1 person in 11





deaths due to diabetes and high blood glucose

Top 5 countries for number of people with diabetes, (20-79 years), 2017



Sources IDF Diabetes Atlas – 8th Edition http://www.diabetesatlas.org/; WHO

Here's how POC testing can be used in situations or in regions where medical services are limited. For example, for an athlete with diabetes competing in a grueling, multi-day race, regular monitoring is vital to maintain optimum health, but may be limited when cycling between cities. POC testing is also being used by dedicated professionals across the globe to manage disease in unexpected locations.

### **Americas**

## Racing Across America with Type 1 Diabetes

By Helen Bär

In 2003, when Thomas Haas was diagnosed with Diabetes type 1, his world fell apart. As a passionate athlete, he questioned whether he could continue pursuing high-performance sports with diabetes. But since he learned that sports and exercise are actually a key component of diabetes therapy, he set his sights high and decided to participate in one of the world's toughest bike races – the Race Across America.

Continuous blood and glucose monitoring was crucial to see Thomas Haas' intense race to a successful finish.



After several years of preparation, in summer 2018, he made his way to the coast of California to start the 3000-mile race across twelve states of America. With 19–20 hours on his bike each day, it took him eleven days to finish the race as the first type 1 diabetic to cross the finish line.

While Haas was riding, his team took care of his nutrition, helped him change his clothes, and provided ice cubes to put in his helmet for the heat. "The team was great – they drove alongside me and assisted whenever necessary," he remembers.

Next to the right preparation and a strong team, medical assistance with continuous blood and glucose monitoring was crucial in such an intense race. The attending physician was regularly monitoring the major parameters, electrolytes and lactate, and could intervene immediately whenever blood values were off or hyper-acidic.

"Checking my blood with the epoc blood analysis device was immensely helpful. We kept a close watch on all the levels and I didn't have any problems at all throughout the entire race," Haas reports. Even though Haas just accomplished the greatest achievement of his athletic career, he is already setting new goals to send a clear message to other patients: "Diabetes is nothing to be scared of."

The organization "Life for a Child" helps over 10,000 young people with Type 1 diabetes in 20 African countries.



### Africa

## Improving Care and Saving Children's Lives in Africa

By Janine Stephen

Type 1 diabetes is often misdiagnosed in many African countries, but Graham Ogle, MD, of Life for a Child is educating patients and health professionals to recognize and treat the disease.

"In many countries, there were very few children living with type 1 diabetes up until a few years ago – because they were dying," says Graham Ogle. In sub-Saharan Africa, almost seven in ten diabetes cases go undiagnosed, and the uncommon disease is often mistaken for other illnesses. Even when correctly diagnosed, under-resourced health facilities may not have vital insulin and blood glucose monitoring equipment.

POC testing is a key tool in areas where patients must travel long distances to access treatment – and can't easily afford to return for results, says Ogle. It's invaluable for diagnosis and long-term monitoring. "The result is available in six minutes," says Ogle. "You can have a discussion on the spot and educate the family." POC HbA1c testing provides "one number that gives you an overall medical picture of how the young person is doing". Regular tests allow health professionals to monitor progress and prevent dangerous complications, such as early signs of kidney disease.

Life for a Child helps over 10,000 young people with type 1 diabetes in 20 African countries. With local partners, it provides the medication

and equipment children need to stay alive. Also important is vital education and support for families and health professionals.

Life for a Child uses local insights in its educational materials (for example, ants are attracted to glucose-rich urine). Doctors and nurses new to treating type 1 diabetes receive a step-by-step guide, "tailored to the resources at their disposal," says Ogle. Mentoring and workshop initiatives with local health partners help spread knowledge. And resources for young people include educational comics, camps, and social media groups for peer-to-peer learning.

Research has proven that education with systematic care and regular testing can dramatically improve mean HbA1c levels – and empower patients to manage their own health. With increased knowledge, type 1 diabetes need not be a death sentence.

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### Texas-Mexico border

## Taking POC Testing to the People of South Texas

By Diana Smith

For almost 17 years, Brian Wickwire, MD, has worked to combat diabetes in South Texas. Hildago County, where he practices, has the highest uninsured population in the U.S. The majority of residents are low-income, and almost 40 percent of the population is obese. Diabetes has left few families unscathed.

To achieve change, Wickwire recognized that information, education, and support had to be more readily accessible to people in the area. He and a dedicated team of professionals launched a program to provide tests and care at a seemingly unlikely spot – a local farmer's market.

In the same place residents buy fresh produce, household items, and special treats like Mexican candy, they can get tested for early kidney disease (the most common complication of diabetes), with results available in minutes. At the market's Pulga Program, health professionals use DCA Vantage analyzers to perform HbA1c and microalbumin tests.

"The ability to go out into a community and provide point-of-care testing is an enormous tool," explains Wickwire. "With that information in real time, within 20 minutes, you can try and help them find a medical home where they can receive definitive treatment and prevent the complications of diabetes, such as blindness and kidney failure, among others."

With real-time information and health education, the Pulga Program team is doing its best to minimize diabetes' devastating effects – one person at a time.

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 quarantee that other customers will achieve the same results.

### **Australian outback**

## Improving Life Expectancy in the Outback

By Garry Barker

For 60,000 years, isolated from other genetic groups, Australia´s Aboriginal people lived on low-fat meat from lizards, snakes, birds, and fish, as well as by gathering the fruits of the earth. Then, 231 years ago, Europeans and other genetic groups began to arrive; migration that gradually changed Aboriginal living and eating habits. Beer, fast food, and sugar have wrought a dreadful penalty upon them, bringing diabetes, cardiovascular and metabolic diseases.

A 2019 report by a group of Australian medical researchers shows that Aboriginal life expectancy, though improved, is still 11 years less than that of non-indigenous Australians; 65 percent of deaths occur before 65 years of age, compared with 19 percent in the non-indigenous population. Indigenous adolescents with type 2 diabetes are over ten times more likely to be hospitalized than non-indigenous adolescents.

Then, in 1999, Professor Mark Shephard, an Adelaide medical researcher and lover of the remote Outback, founded QAAMS (Quality Assurance for Aboriginal & Torres Strait Islander Medical Services) a national indigenous health program, that supports point-of-care diabetes and ACR testing and provides education in healthier living for Aboriginal communities. QAAMS is based at Flinders University in Adelaide and now has 250 DCA Vantage analyzers producing laboratory-standard results and diagnosing cases of diabetes in clinics across the country's rural and remote areas, and the service continues to expand.

"The prevalence of diabetes is four times higher than in non-Aboriginal people and is exacerbated by obesity, poor diet, poor hygiene, and poor water quality," Professor Shephard said, and despite improvements in testing, treatment, and knowledge they remain more vulnerable to diabetes than other Australian communities.

**Conclusion:** POC testing in remote areas can identify diabetes markers and save lives by beginning treatments earlier. Health outcomes have been improved, thanks to POC testing in coordination with medical outposts like these examples from Africa, South Texas, the Australian outback, and on the race course. Underserved communities in remote areas around the globe need to suffer no longer due to a lack of appropriate medical facilities. POC testing technology can be used anywhere, even without a laboratory.

Cameron Martin, Point-of-Care Coordinator, Health Department of Queensland, Australia



### Speaking of collaboration ...

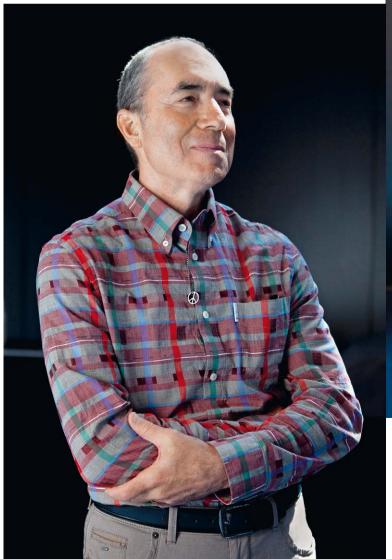
"Even in 2019 residual 'silo mentality' exists between the lab and clinical areas, and even between different clinical specialties. Perhaps this is because the lab was traditionally seen as 'separate' to the clinical areas. Yet with its test results, the lab's advice is crucial to many clinical decisions. The silo mentality leads to inefficiencies and duplication of resources, and places artificial barriers in the healthcare process. We need to break down these barriers and consider healthcare as outcomes rather than just a string of processes.

Pathology results need to be high quality, timely, and be widely available to be clinically useful, no matter which ward the patient is transferred to, or which health professional is making the enquiry. This means a mix of POC testing and lab-based testing, backed up by high quality POC testing middleware, laboratory information systems, and electronic medical records. Patients can be triaged on the basis of their quick POC testing tests in rural and remote areas. On arrival at a larger facility, that initial result is already available to the clinicians there to begin their process."

## High-Sensitivity Troponin I Assays: Quicker Rule-Out,\* Safer Rule-In

Successful introduction of high-sensitivity troponin assays in a hospital is a team effort – and it should not be delayed. With such assays, myocardial infarctions can be detected more accurately, and low-risk patients can be identified quicker. This will reduce the pressure on emergency rooms, while at the same time increase patient safety and patient satisfaction.

Text: Philipp Grätzel von Grätz Photos: Christiane von Enzberg





hether or not a patient has suffered from myocardial infarction (MI) is among the most common and clinically most relevant questions that emergency physicians have to answer. And it is a tricky one: "Nine out of every ten patients who come to the emergency department with chest pain do not have a heart attack," says Professor Nicholas Mills, Chair of Cardiology at the University of Edinburgh and Consultant Interventional Cardiologist at the Royal Infirmary of Edinburgh, Scotland. Neither clinical examination nor ECG can reliably identify a 'true' MI: "Therefore, we absolutely rely on cardiac troponin as a biomarker."

With troponin testing, a paradigm shift is underway. Rapid rule-out pathways that use high-sensitivity troponin assays instead of the far less sensitive contemporary assays have been included in the guidelines,\* for example of the European Society of Cardiology.¹ Rightly so, says Mills: "From an emergency physician's perspective, the advantages are clear: Decisions can be taken quicker, and we can discharge patients who are identified as low risk more safely. This will take pressure from the emergency departments, and it will free up time for evaluating severely sick patients."

### "No good argument not to switch"

In spite of its obvious advantages, the uptake of the new and better assays has been somewhat slow. A recent survey among 2,000 hospitals worldwide showed that an estimated 40 percent are already using high-sensitivity troponin. But Mills expects this number to increase quickly: "Different manufacturers have developed excellent high-sensitivity troponin I tests in recent years. I am convinced that, over the next few years, we will see much more widespread adoption of high-sensitivity tests. There is really no good argument not to switch."

In Scotland, most hospitals have made the switch already. In this context, Mills recently published an independent evaluation of the novel Siemens Healthineers Atellica IM High-Sensitivity Troponin I Assay as part of the larger High-STEACS trial. The Atellica Analyzer is one of four laboratory platforms from Siemens Healthineers, with

the new high-sensitivity troponin I assay being aligned across all of these platforms. It has been available in Europe since May 2017 and received FDA clearance in July 2018. For Mills' study, cardiac troponin was measured in 1,920 patients with suspected acute coronary syndrome.

"In summary, the assay produces excellent results," says Mills. "The limit of quantification is at just around 2 ng/L. This means, we are not talking about ruling in and ruling out myocardial infarction at the 99<sup>th</sup> percentile anymore. We can move to a different approach where we use the test to its full potential." This different approach is one in which rapid rule-out pathways are implemented that use different cut-off levels for an early rule-out and an early rule-in of myocardial infarctions. And this approach makes use of serial testing only in patients in-between these thresholds.

## Two thirds of patients identified as suitable for discharge

The High-STEACS pathway is a good example of a two to three hour pathway, in which myocardial infarction is ruled out without further testing in patients when cardiac troponin I concentration is below 5 ng/L at presentation – provided they don't show signs of ischemia in the ECG. This rule applies to all patients except those who present early within two hours of symptom onset, in which case cardiac troponin is retested three hours after presentation. Patients with troponin concentrations above 5 ng/L, but below the 99<sup>th</sup> percentile, are retested at three hours after presentation.

According to Mills, most Scottish hospitals have been using the High-STEACS pathway for three years now: "When you adopt the high-sensitivity troponin I assay within a High-STEACS framework, it is very effective, and identifies two thirds of all patients in the emergency department as low risk and suitable for discharge." Using the High-STEACS pathway, as Mills points out, was significantly better than using the ESC recommended zero to three hour pathway with a 99<sup>th</sup> percentile cut-off: "When we use the Siemens Healthineers Atellica assay in this manner, we have fivefold fewer high-risk patients that we would miss using the 99<sup>th</sup> percentile alone."

**Urging hospitals** across the globe not to delay the introduction of high-sensitivity troponin assays: Nicholas Mills, MD, **Chair of Cardiology** at the University of Edinburgh and Consultant Interventional Cardiologist at the Royal Infirmary in Edinburgh, Scotland (right) and Fred Apple, Co-Director Clinical & Forensic Toxicology Laboratory Hennepin Healthcare/Hennepin **County Medical** Center, Principal Investigator Cardiac **Biomarkers Trials** Laboratory (CBTL) Hennepin Healthcare Research Institute (HHRI), Professor, **Laboratory Medicine** & Pathology University of Minnesota, USA (left).

\*High-sensitivity troponin assays have not been cleared by the U.S. FDA for rapid rule-out testing.

### Hospitals can choose best pathway

Mills' study not only evaluated the High-STEACS pathway, but also a different rapid rule-out pathway, the ESC one hour pathway, in which the Siemens Healthineers assay worked similarly well. But Mills says that the ESC one hour pathway isn't really suitable for Scottish hospitals: "It has proven impossible for us to really deliver a one-hour turnaround in any of the hospitals that

we work with, and I also don't like the idea of taking another blood test before I know the outcome of the first test."

Having different options available is an advantage, though, because it gives hospitals that plan to implement early rule-out pathways the possibility to choose the pathway that best fits the local needs: "Independently from the pathway, using very low cardiac troponin concentrations to identify low-risk patients has major potential to improve safety and decision-making in the emergency department," says Mills.



Nicholas Mills, MD, Chair of Cardiology at the University of Edinburgh and Consultant Interventional Cardiologist at the Royal Infirmary of Edinburgh, Scotland

### Speaking of collaboration ...

"I think collaboration is critical when introducing a new test, whatever test it is. Establishing a new clinical care pathway that involves laboratory and clinical practice needs to be a partnership. When we introduced high-sensitivity troponin testing in our hospital, we had a group with representatives from the laboratory, from cardiology, and from emergency medicine. This allowed us to develop shared knowledge and introduce high-sensitivity testing into clinical routine really smoothly. In the end, the critical factor is identifying champions within each speciality that pass forward the knowledge. Most importantly, the laboratory team needs to take an active role. Don't just release the test and then wait for the feedback!"

### Successful switches: education and teamwork

So how to successfully switch to high-sensitivity troponin assays in a hospital that is still doing it the contemporary way? For Professor Fred Apple, Co-Director Clinical & Forensic Toxicology Laboratory Hennepin Healthcare/Hennepin County Medical Center, Principal Investigator Cardiac Biomarkers Trials Laboratory (CBTL) Hennepin Healthcare Research Institute (HHRI), Professor, Laboratory Medicine & Pathology University of Minnesota, USA, successful transformation projects in cardiac troponin testing are all about education – and about teamwork: Laboratorians, cardiologists, and staff in the emergency department need to work together closely. Specific recommendations on how to implement high-sensitivity troponin testing have been listed in the recent AACC/IFCC joint publication "Clinical Laboratory Practice Recommendations for Use of Cardiac Troponin in Acute Coronary Syndrome". This publication contains a number of clear recommendations to help laboratories as well as cardiology and emergency departments to move smoothly from the old world into the new one.

## High-sensitivity troponin I: "No increase in number of patients tested positively"

Importantly, Apple says, certain preconceptions should be addressed proactively. One of these preconceptions is that high-sensitivity troponin assays lead to a steep increase in the number of patients that end up in the cath lab. This preconception, according to Apple, goes back to the introduction of the first high-sensitivity troponin T assay that indeed reported a steep increase in the number of patients tested positively. The reason, however, was that the older

"contemporary" troponin T assays had missed a considerable number of patients with troponin elevations. With the recently introduced highsensitivity troponin I assays, the situation is totally different, says Apple: "The contemporary troponin I assay of Siemens Healthineers, for example, is a very good assay. Switching to the new high-sensitivity assay will clean up the 'noise' and allow an early rule-out, but we won't see a dramatic increase in the number of patients that are tested positively."

Professor Mills can confirm this by experience: "When we introduced high-sensitivity troponin I testing, we noticed no difference at all in our day to day workflows. Depending on how low the troponin threshold was with the contemporary assay, the number of patients that are identified with an abnormal result might increase by one in 25. But this is not the sort of thing that you notice on a day to day basis." Furthermore, Mills emphasizes, with the high-sensitivity tests, clinicians can be sure that these patients genuinely have some other sort of myocardial injury: "So they will benefit from seeing a cardiologist, whether they need an angiogram or not."

## Gain in precision by sex-specific cut-offs

Another group of patients who will strongly benefit from switching to high-sensitivity troponin assays, according to Mills, is women. The reason is that high-sensitivity troponin I assays, unlike contemporary troponin assays, offer the possibility to define sex-specific cut-off values: "When we use a conventional single threshold assay, we are disadvantaging women. Adopting sex-specific criteria will increase the proportion of women identified with myocardial infarction and allow us to initiate proper treatment as early as possible."

Given the wealth of data that exists on highsensitivity troponin testing, Fred Apple urges hospitals all over the world not to delay introduction of the modern assays: "It makes complete sense for hospitals to embrace this new technology and get rid of the old assays quickly. Imagine you were a patient: When you show up in a hospital with chest pain, you expect an assay that is going to give you the best results."

**Philipp Grätzel von Grätz** is a Berlin-based medical doctor turned independent writer. His focus is on biomedicine, medical technology, health IT, and health policy.

Fred Apple, MD, Co-Director Clinical & Forensic Toxicology Laboratory Hennepin Healthcare/Hennepin County Medical Center, Principal Investigator Cardiac Biomarkers Trials Laboratory (CBTL) Hennepin Healthcare Research Institute (HHRI), Professor, Laboratory Medicine & Pathology University of Minnesota



### Speaking of collaboration ...

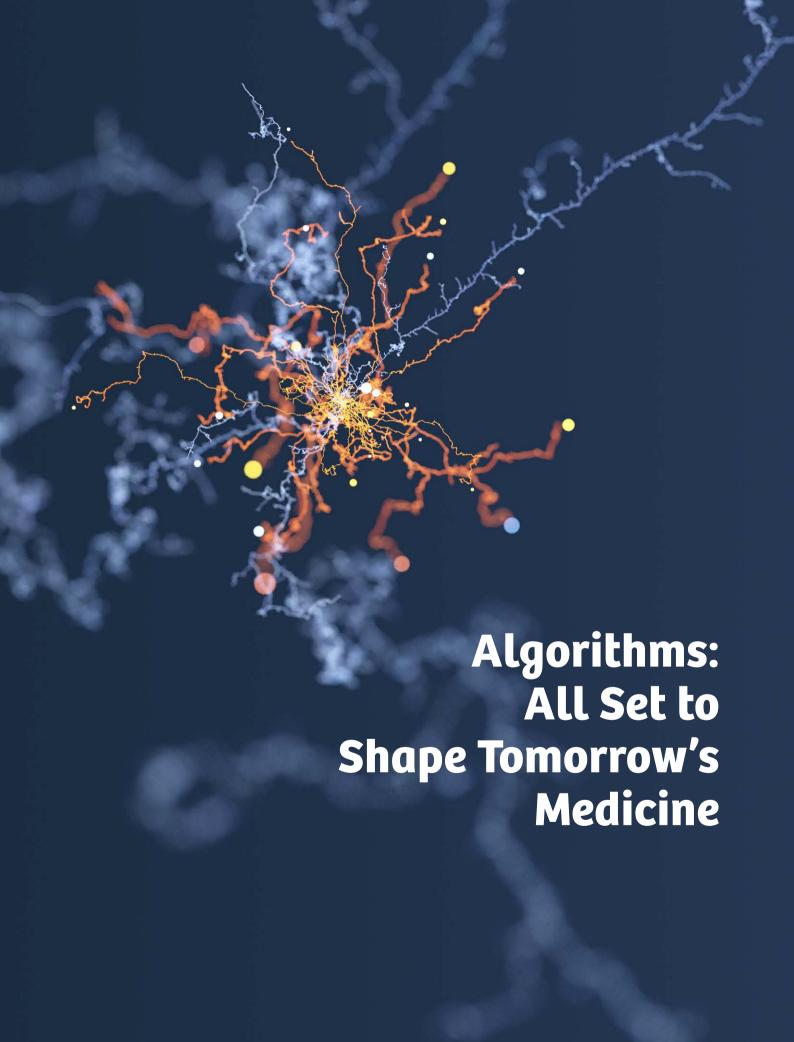
"For applied scientists, laboratory physicians, and practicing physicians, working together is the key to success in today's world. No one can do it alone; those days are definitely over. When I train my own laboratory medical residents and fellows, I recommend that they go out into the clinical settings and find like-minded people in the emergency medicine department and in the cardiology department – like-minded people who they can work with and who understand biomarkers. Don't try to be the one who has all the answers and takes all the decisions. Work as part of a team. When implementing new biomarkers, we need uniform decisions among all involved disciplines in order to make the transition a success."

<sup>1</sup> Also implemented in the expert consensus document of ESC, ACC, AHA and WHF: Fourth universal definition of myocardial infarction (2018)

Product availability may vary from country to country and is subject to varying regulatory requirements.

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Nicholas Mills, MD, receives financial support from Siemens Healthineers for collaborations.



rom virtual assistants in the living room to intelligent investment algorithms and from software-based traffic control to autonomous driving – there is no escaping artificial intelligence (AI) and machine learning. The topic is also currently being addressed at the political level. China presented its Next Generation Artificial Intelligence Development Plan as far back as July 2017. In March 2018, French President Emmanuel Macron announced that his government would invest a total of €1.5 billion in Al by 2022. In April 2018, the British government launched its £1 billion AI Sector Deal policy paper. In May, it was Sweden's turn. The German government unveiled its AI strategy at the end of 2018. At the European level, the European Commission formulated a European AI Strategy in April 2018, setting out the draft European Al ethics guidelines a year later.

## Practical uses for AI thanks to increased computing power

The advance of AI can be seen in medicine, as well. From prevention and screening to diagnosis, therapy, and disease management, innovative companies and technology-oriented medical institutions have been developing, testing, and —

Across all medical disciplines, artificial intelligence and machine learning will transform medicine beyond most people's imagination. Algorithms that help evaluate radiological images are just the beginning. Al could become an indispensable tool in all branches of medicine.

Text: Philipp Grätzel von Grätz

increasingly – implementing intelligent algorithms in virtually every branch of medical care. At the same time, regulators are turning their attention to the topic. In February 2019, the U.S. Food and Drug Administration (FDA) released a discussion paper regarding the licensing of Al applications for medicine. It is not concerned with 'simple' applications that are trained and re-trained during updates – such solutions already exist and have regulatory approval. Rather, the new FDA initiative concerns more sophisticated Al systems that learn in real time and are constantly changing their algorithms, requiring them to be regulated differently from traditional software solutions.

The distinction between 'static' and 'dynamic' AI, which the FDA is now also addressing, shows that artificial intelligence is a very broad, vaguely defined term. Today, when people talk about Al, they usually mean deep learning, a special form of machine learning using artificial neural networks. It has become known through the Google algorithm which succeeded in beating the world Go champion. But in fact, neural networks have existed for decades. "Computing power is what has changed most. The increase in power has allowed for algorithms, which have been around for a long time, to be put to practical use," says Bram Stieltjes, MD, Head of Research Coordination at the Radiology & Nuclear Medicine Clinic at University Hospital Basel, Switzerland. Graphics cards - essential tools for training neural networks - have also become much more powerful.

## "Mathematical revolution in radiology"

This training of neural networks - often involving tens of thousands of datasets - has made headlines, especially in radiology where algorithms now perform better than radiologists on certain questions. Professor Stefan Schönberg, Chairman of the Department of Clinical Radiology and Nuclear Medicine at the University Medical Centre Mannheim, Germany, speaks of a "mathematical revolution in radiology". Analyzing images is one thing, he says. But in an age of radiomics, algorithms sift through multidimensional data sets using high resolution that investigate data sets down to single voxels. "It's not at all clear whether we are looking at images or at purely statistical parameters," Schönberg says. >



Professor Stefan Schönberg, Chairman of the Department of Clinical Radiology and Nuclear Medicine at the University Medical Centre Mannheim, Germany



Professor Michael
Forsting from the
Institute of Diagnostic and Interventional
Radiology and
Neuroradiology
at Essen University
Hospital, Germany



Professor Frederick Klauschen from the Institute of Pathology at Charité Berlin, Germany

The fear, as it is sometimes spread by the media, that algorithms could replace radiologists is not shared by experts: "Most radiologists don't see Al as a threat but as something beneficial to the field," says Professor Michael Forsting from the Institute of Diagnostic and Interventional Radiology and Neuroradiology at Essen University Hospital, Germany. Algorithms can handle the repetitive, time-consuming activities and thereby lighten the radiologists' everyday workload, according to Forsting. "For example, here in Essen

we have automated the counting of multiple sclerosis lesions in the brain. We also use algorithms to determine bone age, and in the early detection of strokes."

### AI to make inroads into labs

In other diagnostic disciplines, self-learning algorithms could lead to far-reaching change in the next few years. Right at the forefront is pathology, which produces enormous datasets that have not yet been fully evaluated. "The first step will definitely be an increase in efficiency thanks to AI," underlines Professor Frederick Klauschen from the Institute of Pathology at Charité in Berlin, Germany, at an event of the Federal Association of German Pathologists. Pathologists think it likely that algorithms will quite soon, for instance, take over the task of counting cell nuclei. This would free them and their colleagues up for more complex tasks.

In the medium term, Klauschen can also imagine algorithms being used for quite different evaluations, including analyses that are difficult without Al. For instance, there are indications that self-learning algorithms are better than humans at recognizing complex biomarker patterns in cancer patients. These patterns could then be used in precision medicine instead of single parameters to predict which patients will respond to immunotherapies.

With regard to biomarkers, Al algorithms are also likely to trigger some developments in laboratory medicine – the third major diagnostic field aside from pathology and radiology. In a Siemens Healthineers survey of 200 clinical laboratory executives, seven out of ten respondents said Al would move into in vitro diagnostics (IVD) over the next four years. As many as nine out of ten were convinced that Al would have a significant long-term impact on healthcare. Every second respondent had already been using Al applications in laboratory medicine.[1]

### Will diagnostic specialists become redundant?

In laboratory work, there is an interest in algorithms that support operational processes. For example, in cross-lab monitoring of diagnostic systems, AI can detect problems before failures occur, allowing for proactive maintenance schedules. On the clinical side, algorithms are suited to diagnostic decision-making in laboratory

medicine and also, similar to pathology, to predictive analytics based on complex biomarker patterns.

One particularly promising use is the holistic analysis of diagnostic information, in which algorithms collate data from the laboratory, electronic patient record, imaging, and sometimes pathology. Bram Stieltjes of University Hospital Basel sees this Al-supported 'interdisciplinarity' as one of the ways in which algorithms directly impact clinical practice in the diagnostic fields: "It's possible that the roles of radiologist, pathologist, and laboratory physician will cease to be separate in the future. Perhaps we will become total integrators of diagnostic information, working together more closely in integrated diagnostic departments to bring together all the pieces of the diagnostic puzzle as quickly as possible."

### AI and narrative-based medicine

Radiology, pathology, and laboratory medicine – these are all very technical fields that are already highly digitized in many areas. It comes as no surprise that this is where a lot of discussions about medical AI are taking place. Michael Forsting, who is responsible for the annual Emerging Technologies in Medicine (ETIM) congress – which addresses medical AI applications far beyond radiology – is convinced this is a passing phenomenon: "In the long run, the technical disciplines will change much less than narrative-based and clinical medicine."

Why is that? "Simply because most mistakes happen in non-technical areas, and AI can reduce errors," says Forsting. As an example, the radiologist cites algorithm-based applications that use voice, facial expression, and posture to make a tentative diagnosis of depression. These algorithms are increasingly being tested in clinical trials. They could be very useful, for instance in situations where a doctor who is not a psychiatrist sees a patient who is supposedly suffering from a purely physical ailment.

Geneticists and bioinformaticians from the U.S. and Germany reported on a rather different use in the journal Nature Medicine at the start of 2019. The scientists have developed a network of algorithms called DeepGestalt, which has been trained to detect rare genetic diseases through facial photography. After training on 17,000 images of patients with over 200 different genetic syndromes, it analyzed a total of 502 facial



Bram Stieltjes, MD, Head of Research Coordination at the Radiology and Nuclear Medicine Clinic at University Hospital Basel, Switzerland

### Speaking of collaboration ...

"It's possible that the roles of radiologist, pathologist, and laboratory physician will cease to be separate in the future. Perhaps we will become total integrators of diagnostic information, working together more closely in integrated diagnostic departments to bring together all the pieces of the diagnostic puzzle as quickly as possible."

photographs of a typical patient group in human genetic consultations. In nine out of ten patients, the correct diagnosis was among the first ten suggestions.[2] DeepGestalt could be of enormous help, especially in regions where there are no rare hereditary disease specialists. "Al can bring about huge improvements in narrative-based and clinical medicine," Forsting is convinced. •

Philipp Grätzel von Grätz is a Berlin-based medical doctor turned independent writer. His focus is on biomedicine, medical technology, health IT, and health policy.

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## Fighting Sepsis at the Point of Care

Every year, sepsis is diagnosed in over 1.7 million adults in the United States and at least 270,000 Americans die from sepsis.[1] Sepsis represents the biggest U.S. hospital expense, totaling around US\$ 24 billion annually.[2] Nationwide, hospitals are adopting new screening programs to improve rates of early recognition and treatment of sepsis to prevent progression from severe sepsis to septic shock, and reduce the numbers of deaths and length of hospitals stays due to sepsis.

Text: Linda Brookes

untsville Hospital, a 971-bed community-owned, publically owned facility in the city of Huntsville, Alabama, has been among the leaders in improving protocols and education focused on sepsis. Kristie M. Campbell, Administrative Director of the Huntsville Hospital Clinical Laboratory, described how point-of-care (POC) testing was integrated into the hospital's sepsis protocol. "We wanted to expand its services to be truly competitive with other hospitals in the southeast region of the

U.S., and to ensure that testing was done as efficiently as possible," she recalled.

### Introduction of point-of-care testing

"POC testing has become integrated in how we care for our patients," Campbell emphasized.
"Clinicians want it everywhere we care for patients in our hospital." For these "early adopters" of POC handheld technology, the epoc Blood Analysis handheld device represented a "natural

progression" of the POC testing that was introduced about 22 years ago. The hospital began using the device in cardiovascular operating rooms and intensive care units (ICUs) in 2009, followed by a phased rollout in other departments and ICUs.

The POC lactate test was added to the epoc device as part of the hospital's sepsis initiative. Decreasing the time between taking blood from the patient to the result being available to the clinician ("vein to brain time," as Campbell likes to call it), is critical. "For every hour you wait to give an antibiotic to a patient with sepsis, the mortality risk of that patient increased by eight percent," she noted.[3] "With a handheld device, the nurse can get test results within three minutes."

### The sepsis "bundle"

Campbell recalled that on the first floors where the sepsis program was introduced, mortality over the initial three to six months decreased by almost 50 percent, "a very astounding number." Huntsville Hospital also participated in a study during which they found that around five percent of patients with an initially negative lactate result (<2.0 mmol/L) went on to develop septic shock. So the recommendation to do a repeat assay within hours after an initial negative assay was adopted.

Patients presenting with sepsis at the hospital are managed following guidelines that recommend a set of five interventions, collectively known as a 'bundle,' to be carried within a critical window after recognition of sepsis. The bundle consists of measurement of lactate, along with blood cultures, administration of fluids and antibiotics, and, if necessary, initiation of vasopressor therapy, all to be started immediately. The guidelines emphasize how randomized controlled trials have shown that lactate-guided resuscitation leads to a significant reduction in mortality. Following evidence that faster completion of the bundle is associated with lower in-hospital mortality,[4] the latest guideline sets a one-hour goal for completion.[5] "There would be no way we could meet those milestones and criteria without using POC lactate," Campbell concludes. "It is crucial to our care for all of our patients in our hospital." •

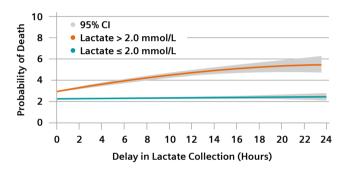
**Linda Brookes** is a freelance medical writer and editor who divides her time between London and New York, working for a variety of clients in the healthcare and pharmaceutical fields.

"There would be no way we could meet those milestones and criteria without using POC lactate."

**Kristie M. Campbell,** Administrative Director, Huntsville Hospital Clinical Laboratory, Alabama, USA



## Early Lactate Measurements Make a Difference

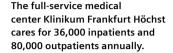


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## Automating Lab Inventory Management

Klinikum Frankfurt Höchst, Germany, found many inefficiencies in its laboratory inventory management processes – and a way to save time, reduce costs, minimize errors, and streamline regulatory compliance.



By implementing a laboratory inventory management system, Klinikum Frankfurt Höchst streamlined its supply management.

linikum Frankfurt Höchst cares for 36,000 inpatients and 80,000 outpatients annually. The full-service medical center in the largest municipal hospital network in Germany's Rhein-Main region constantly improves its processes for providing the highest levels of patient care. Its laboratory provides a diverse array of services: classical clinical chemistry, immunochemistry, infection serology, hematology, hemostasis, blood-bank services, and microbiology testing. It performs 3.6 million tests annually, consuming on average 300,000 tubes and 25,000 cartons of reagents and other testing supplies.

## Manual inventory management consumes valuable staff time

When reviewing its laboratory inventory management processes, it found many inefficiencies. With no centralized order management in place, responsibilities were spread among multiple staff members in the core, serology, and hematology labs. Each highly trained staff member

took time away from other professional responsibilities to manually conduct inventory checks and ordering. Among staff members, opinions differed on appropriate minimum stock levels. Coordination and communication regarding inventory were difficult when staff were out on sick leave or time off. In addition, processing the multitude of order documents and tracking product numbers posed a high administrative burden.

In the typical manual inventory model prevalent in most laboratories today, the biggest consumer of time is the counting of boxes – repeatedly – in the refrigerator and on shelves. Then, when an order is required, it is manually composed and submitted. Comprehensive documentation and tracking of inventory is another time-consuming task. This is becoming more important as many regulators are seeking detailed inventory management documentation.

Klinikum Frankfurt Höchst aimed to free up its lab staff from these tasks and enable them to focus on the high-skill jobs they had been hired to perform. The laboratory wanted to ensure total control over inventory by stocking the right products in the right quantities on its shelves with all the documentation needed to simplify, and adhere to, regulatory compliance. "Our lab is the central lab for the entire 1000-bed hospital, and we also serve external hospitals and physician offices," says Oliver Colhoun, MD, laboratory director at Klinikum Frankfurt Höchst. "We need to deliver fast, high-quality results 24 hours a day, with as little cost and personnel deployment as possible. After achieving good results automating our analytic processes with Siemens Healthineers solutions - including pre- and post-analytics – we realized that the management of consumables still represented a large amount of invested labor. That became the next area we targeted for increased efficiency."

## Automating for operational efficiency

At first, the medical center considered a barcode label system for tracking inventory. Then it learned about a newer, more powerful technology: Atellica Inventory Manager (Atellica IN). Atellica IN is a cloud-based inventory-management system that improves control over all stages of the inventory-management process with an easy-to-navigate dashboard accessible with role-based security from any Internet-connected computer, tablet, or smartphone with a web browser.

Atellica Inventory Manager reduced the time checking inventory prior to ordering supplies from 25 minutes to five minutes.



Atellica IN uses wireless radio frequency identification (RFID) to automatically track inventory consumption across multiple laboratories in real time. Supported consumables include reagents, calibrators, controls, and ancillary products from Siemens Healthineers or third parties. When items reach critical levels as defined by customized reordering rules, Atellica IN sends email alerts and proposes orders through a cloud-based service. No manual intervention is needed to construct an order. When new products arrive —

often within 24 hours – staff members check them in, label them with the received date, expiration date, and lot numbers, and place them into storage locations such as freezers or refrigerators.

"With Atellica Inventory Manager, we work within a structured order process that enables massive time savings for professionals," Colhoun says. "We get a total, real-time overview of all items in stock without counting boxes. Atellica IN knows what needs to be ordered, and staff can complete purchase orders at the push of a button."

#### Klinikum Frankfurt Höchst sees time savings of 35 percent

When implementing Atellica IN, Klinikum Frankfurt Höchst faced the challenge of how to deploy the system over its multi-floor building layout. Siemens Healthineers consultants demonstrated Atellica IN's built-in ability to adapt to different infrastructure layouts and laboratory settings, and a two-floor setup was installed at the hospital.

The next hurdle was to build laboratory staff confidence in Atellica IN. The staff members who had handled inventory management manually were hesitant to fully trust the automated system. Within two weeks, however, Atellica IN proved its reliability as well as its efficiency advantages. By automating inventory management, the medical center has achieved total time savings of 35 percent.

Among individual tasks, the time it takes to check inventory before ordering has dropped from 25 minutes to five minutes, saving up to four hours per week. Placing an order manually used to take approximately 45 minutes several times a week, including manually counting stock inventories at different storage locations, filling in purchase order forms, and sending them by fax.

Costs are lower too. With Atellica IN providing inventory and expiration-date alerts, as well as backorder information, the medical center has nearly eliminated the extra expense and workload associated with emergency orders. Optimizing inventory levels reduces holding costs for excess supplies and waste due to product expiration. The system reduces human error while freeing staff to return to high-value work, which in turn increases job satisfaction and morale.

Ultimately, a lab's mission is to support highquality patient care by providing clinicians with "Atellica Inventory
Manager centralized
everything. We get
a total overview of all
items in stock and
can complete purchase
orders at the push
of a button."

**Oliver Colhoun, MD,** Laboratory Director, Klinikum Frankfurt Höchst, Germany



fast, accurate test results. Atellica IN supports this mission by making sure that no supply issues impact turnaround time or staff efficiency.

"With defined minimum stock levels and a consistent order process, Atellica Inventory Manager enables us to consolidate the ordering processes of multiple departments while also customizing for different lab requirements," Colhoun says. "Staff found it easy to learn the system, and our highly skilled med techs are delighted to use their time for medical- and lab-related work instead of counting packages and submitting orders. Such efficiencies support the highest quality of patient care."

## Automated visibility for compliance documentation

The solution also simplifies regulatory compliance. Klinikum Frankfurt Höchst follows RiliBÄK German Medical Association quality guidelines and maintains the highest levels of accreditation. In the past, the medical center documented its inventory management manually. Now, Atellica IN tracks supplies and orders automatically, including delivery date, check-in person, date consumed, expiration, lot, and other factors. Order data can be printed, emailed, or exported to Excel spreadsheets, and the software can analyze consumption patterns.

"It would be very difficult for us to manually adhere to increasing quality regulations," Colhoun says. "Even with stricter requirements, Atellica Inventory Manager's statistics tool is very useful and accepted for documentation purposes."

## Forward-thinking institution embraces quality-enhancing efficiencies

Klinikum Frankfurt Höchst has been a forward-thinking Siemens Healthineers customer since 2006. The hospital stays up to date on instrument and assay advances and enhances its administrative processes to improve outcomes. Leveraging Atellica IN to track, manage, and order consumables and analyze laboratory inventory data, Klinikum Frankfurt Höchst improved resource utilization, cut costs, saved labor time, improved quality, and gained end-to-end visibility for easier regulatory compliance.

"The biggest benefits to us are improved staff utilization, standardized order processes, and reduction of inventory stocks," Colhoun says. "Atellica Inventory Manager has transformed our inventory-management process. We consider it essential to the optimal efficiency of a modern healthcare institution."

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.





Like hospital laboratories across Europe, José Luis Bedini, MD, (fourth photo from left) and his colleagues in Barcelona are consolidating their testing systems to achieve higher efficiency.







## Streamlining Laboratory Services To Do More With Less

Hospital laboratories are challenged nowadays to meet greater testing demands, improve efficiency, and deliver reliable, high-quality results while at the same time facing problems of space, a shortage of skilled employees, and budget constraints. Core laboratories at a number of hospitals are exploring ways to further improve their performance by consolidating their routine and urgent (STAT) testing systems to achieve reductions in work time, space, manpower, and costs.

Text: Linda Brookes | Photos: Walther Appelt



The Core Laboratory at Hospital Clinic Barcelona in Spain.

## Improved performance with consolidation

In Europe, six high-volume laboratories were among the first to address these challenges by introducing immunoassay and clinical chemical analyzers run on the multicomponent Atellica Solution. To verify their concordance, precision, linearity, and detection capability as well as their workflow capabilities, the sites (Hospital Universitario La Paz and Hospital Clinic Barcelona in Spain; LBM Bioesterel and Hôpital Beaujon in France; Santa Maria Nuova Hospital, Reggio Emilia in Italy; and Friarage Hospital in the UK) ran twenty commonly used assays following Clinical and Laboratory Standards Institute (CLSI) quidelines.

Antonio Buño Soto, MD, PhD, Head of Laboratory Medicine at Hospital Universitario La Paz, Madrid, Spain, recently described how the findings for the 13 chemistry and seven immunoassays showed "precision that met or exceeded coefficients of variations (CVs) in the Instructions for Use, concordance with existing technology with correlation values close to one, and acceptable linearity across the assay range."

The Atellica Solution also improved workflows in terms of daily maintenance, quality control (QC), and reagent loading. Typical daily workloads were replicated at two of the laboratories; Core Laboratory at Hospital Clinic Barcelona in Spain; and LBM Bioesterel, in Mouans-Sartoux, France,

where hands-on time in the labs was reduced by 60 percent and 73 percent, respectively. This was attributed in large part to automated maintenance, onboard refrigerated, automated QC, and on-the-fly reagent loading, according to José Luis Bedini, MD, Head of the Barcelona laboratory. The number of analyzers needed at both sites was reduced by 33 percent.

#### Simultaneous STAT and routine tests

The Hospital Universitario La Paz, which currently uses an independent dedicated lab for STAT testing, also investigated whether the Atellica Solution could run STAT tests along with routine testing. Buño Soto and his colleagues used 650 routine samples with 1,561 immunoassay test requests corresponding to a typical three-hour peak daily work period along with a representative number of STAT requests corresponding to the same period. For the STAT tests, high-sensitivity troponin I (TnIH), B-type natriuretic peptide (BNP), and total hCG (thCG), the mean time from sample aspiration to result was around ten minutes - "very impressive," Buño Soto said. Variability was "really low" (CV 4-6), and routine samples were not impeded by STAT testing and also demonstrated fast, predictable TAT.

#### Fast troponin testing crucial

A 7-year study highlighted the need for improved medical care during emergency admission for suspected myocardial infarction in Spain, so the need for cardiac troponin STAT tests was even more critical, Buño Soto stressed.[1] In Madrid, the Atellica IM TnIH Assay run on the Atellica Solution showed good precision in detecting low concentrations and good correlation with established ADVIA Centaur® and Dimension Vista® TnIH assays.

One of the assay tests run by the Santa Maria Nuova Hospital, Reggio Emilia, assessed the impact of interfering substances (like the vitamin biotin) on the performance of the high-sensitivity troponin assay. There was less than 10 percent change in results with biotin ≤1500 ng/mL and hemolysis ≤500 mg/dL. According to Tommaso Fasano, MD, PhD, from the Arcispedale Santa Maria Nuova in Reggio Emilia, Italy, both the Atellica and ADVIA Centaur are "good assays," but the Atellica Assays "seem to be even better." In their Clinical Chemistry and Endocrinology Laboratory, Fasano and colleagues found that the Atellica IM TnIH Assay showed "very low CVs" at concentrations close to the 99th percentile

(2.5 percent at 40.3 ng/L, 99<sup>th</sup> percentile 45 ng/L). In samples with undetectable levels of troponin on a "contemporary sensitive assay" (ADVIA Centaur TnI-Ultra), detectable levels of troponin (>limit of quantitation (LoQ)) were found in 70 percent on the Atellica IM TnIH compared with 61 percent on the ADVIA Centaur TnIH.

#### Laboratory upgrade plans

For Hospital Universitario La Paz in Madrid, the central routine and urgent testing labs together perform over eleven million laboratory tests per year. Planning is underway to merge the two testing facilities, which Buño Soto anticipates will allow staff to spend more time on clinical work and less time on manual operations, while facilitating faster, more efficient triage of patients presenting with critical symptoms.

At Hospital Clinic Barcelona, the current annual workload is 5.4 million tests performed by seven operators (six for routine and one operator for STAT samples). Following re-evaluation of the workflow and impact of the Atellica Solution already in use, the lab decided to replace the current ten connections with just three Atellica Solution configurations connected to Aptio Automation, removing the need for a dedicated STAT area. Bedini expects this reorganization to lead to a 25 percent reduction in necessary workspace and allow redeployment of three operators. "These important changes to the organization of the lab will lead to more capacity, more throughput, and greater productivity," he predicts.

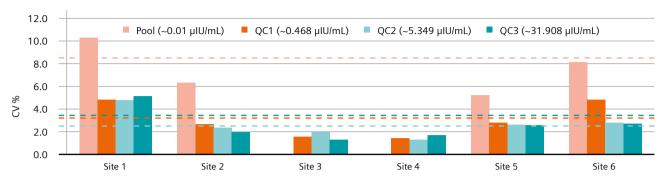
**Linda Brookes** is a freelance medical writer and editor who divides her time between London and New York, working for a variety of clients in the healthcare and pharmaceutical fields.

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- <sup>1</sup> Siemens Healthineers supported the study by providing systems, reagents, and protocols and contributed to data analysis.
- <sup>2</sup> Product availability varies from country to country and is subject to varying regulatory requirements. Results from case studies are not predictive of results in other cases. Results in other cases may vary.

## Atellica IM assays: within-laboratory precision studies Atellica IM TSH3-Ultra assay

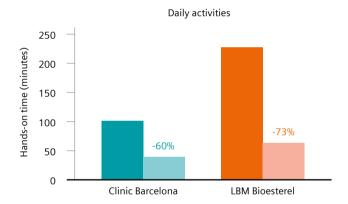
For the Atellica TSH 3-Ultra assay, the precision studies were conducted using 3 levels of QC as well as a pool sample at a concentration of approximately 0.01 µIU/mL to demonstrate the precision obtained at the low end of the assay.

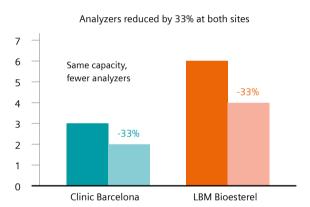


Study site data: 5-day precision study, 5 runs per day,  $N \ge 25$  for each sample – CLSI Protocol EP15-A3. IFU data: Precision was determined in accordance with CLSI Document EP05-A3.16. Samples were assayed on an Atellica IM Analyzer in duplicate in 20 runs per day for 20 days ( $N \ge 80$  for each sample). Sites 3 and 4 did not perform precision testing on pool sample. QC: Bio-Rad Liquicheck Immunoassay Plus Control lot 40940T

## Finding: Simplified, automated processes reduced manual labor, giving professionals more time for clinical analysis

Automated maintenance, QC, and material loading reduced hands-on time compared to current analyzers.





#### Atellica IM TnIH Assay<sup>2</sup> – Overview of assay performance and study protocol

The Atellica IM High-Sensitivity Troponin I (TnIH) Assay provides confidence in results that allow clinicians to effectively triage cardiac patients.

Characteristic	Atellica Solution
Technology	Performed latex magnetic solid phase with new TSPAE molecule
Antibodies	mAb (sheep and mouse), recombinant sheep monoclonal $\boldsymbol{F}_{ab}$
Sample volume	100 μL
Time to first result (min)	10 minutes
99 <sup>th</sup> percentile	Lithium heparin (combined M/F): 45.20 ng/L; Serum (combined M/F): 45.43 ng/L
LoD	1.60 ng/L
LoQ (dose at 20% CV); Dose at 10% TCV	2.50 ng/L; < 6.00 ng/L
Interferences ≤ 10% change in results up to:	Biotin – 3500 ng/mL; hemoglobin – 500 mg/dL

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# Innovative Precision Medicine in Braunschweig

Braunschweig Municipal Hospital has installed a ground-breaking process for molecular tumor analysis using next-generation sequencing (NGS). We spoke to the hospital's medical director, Thomas Bartkiewicz, MD, and the head of the Department of Pathology, Ansgar Dellmann, MD, about the role that tumor analysis plays in oncology at the hospital and about the collaboration with Siemens Healthineers subsidiary NEO New Oncology, which executed the project.

Photos: Peter Sierigk



#### **Next-generation sequencing**

In recent years, personalized cancer therapies have brought about a paradigm shift in oncology. The therapies address specific changes in a tumor's genome. This means they are more effective and have fewer side effects than nonspecific chemotherapy. However, changes within the tumor can vary from patient to patient. For a targeted treatment to have the desired results, it is therefore important that physicians understand the molecular properties of the individual cancer. This is why a comprehensive molecular analysis of the tumor profile must precede the treatment itself. Braunschweig Municipal Hospital uses NEO technology for this. Based on next-generation sequencing (NGS), the technology enables fast and efficient parallel multiplex analysis of therapy-relevant changes.



Colleagues Jens Christmann, PhD, and Horst Hannig, PhD, working in the lab

ow does molecular tumor
analysis fit into the overall direction of Braunschweig Municipal
Hospital?

Thomas Bartkiewicz: As a maximum-care hospital in our region, we aim to provide care at the level of a university hospital. In order to live up to this, we have made oncology one of our focus areas and are certified as a national cancer center by the German Cancer Society. We're proud of that, but of course it also motivates us to remain at the cutting edge of diagnostics and therapy. Innovative molecular diagnostics plays a crucial

role in this, because it allows us to offer truly personalized cancer therapies.

Ansgar Dellmann: We've been doing molecular diagnostics in pathology for quite a while now, but now the NGS-based technology has given us a wonderful tool for really providing the best therapies to patients here in the Braunschweig region. Nevertheless, pathologists are obviously still required to identify tumors under the microscope before we perform molecular characterization to be able to deliver the best treatment possible.

## How has the use of NGS technology changed things for your submitters?

**Dellmann:** In some cases, we had to start by communicating the enormous advantages of receiving information about a large number of genetic changes. We've significantly expanded the spectrum of tests we offer for lung cancer, which our submitters are very pleased about. The test results are also included in our hospital tumor conferences, where we discuss the treatment options for our patients.

## Why did Braunschweig Municipal Hospital choose NEO New Oncology as its partner?

**Dellmann:** The key thing for us is that we receive the molecular analysis results in a form that allows us to use them in routine diagnostics. Because the analysis produces large amounts of data, we need to be able to interpret the data quickly and easily here at the hospital. NEO New Oncology offers technology that does just that. **Bartkiewicz:** The service culture was also a deciding factor. NEO is a European leader in customeroriented service.

## How have the possibilities offered by the new diagnostics changed the hospital's position?

Dellmann: We can offer very good comprehensive tumor analyses at a university-hospital standard. Obviously we're proud of that, but the most important thing is that we can offer our patients optimal care within a narrow time frame. We don't have to send any tumor samples for testing, which means we don't lose any time and can start treatment as soon as possible.

Bartkiewicz: I think that our use of NGS helps us stand out among municipal maximum-care providers in Germany.

## How do you use the technology at the moment, and what are your plans for the future?

**Delimann:** We mainly use molecular diagnostics for lung cancer at the moment, but it's very likely to develop in the direction of breast cancer and gastrointestinal cancer. For instance, we've spent a long time supporting a patient who has a typical adenocarcinoma in the lung and has undergone several therapies already.



#### **NEO New Oncology**

NEO New Oncology is a subsidiary of Siemens Healthineers based in Cologne, Germany. It specializes in solutions for indication-independent analysis of solid tumors. NEO technology enables reliable and highly sensitive detection of therapy-relevant point mutations, small insertions and deletions, copy-number alterations, as well as translocations in oncogenes and tumor suppressors. The hybrid-capture technology includes full bio-informatic analysis of the sequencing data obtained.

For more information, visit newoncology.com

"Our use of NGS helps us stand out among municipal maximum-care providers in Germany."



Medical Director, Braunschweig Municipal Hospital, Germany

With this patient, NGS allowed us to identify a mutation that means we can put her on a new kind of medication that will help her to survive. Here in Braunschweig, we also sometimes use the method with patients who have colorectal cancer since this type of cancer demands extensive action.

**Bartkiewicz:** The crucial thing for us is that the partnership with Siemens Healthineers and NEO New Oncology keeps us fit for the future. It allows us to access new fields of indications for molecular tumor diagnostics that are only just emerging.

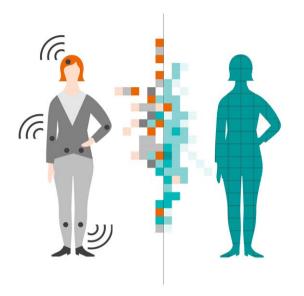
**DelImann:** My wish is that every tumor diagnosed in our hospital is also analyzed with NGS. This will eventually be the case, but I want to achieve the goal as quickly as possible. I think we'll get there in three or four years' time. ●



"The key thing is that we receive the genetic tumor data in a form that allows us to use them in routine diagnostics.

Because the analysis produces large amounts of data, we need to be able to interpret the data quickly and easily here at the hospital. NEO New Oncology offers technology that does just that."

Ansgar Dellmann, MD, Head, Department of Pathology, Braunschweig Municipal Hospital, Germany



## **Experiencing the Future** of Surgery

What molecular biology research is to internal medicine, technological progress is to surgery: Miniaturization, automation, precision imaging, digitalization, and artificial intelligence are opening up new avenues. But what, exactly, will surgery look like in twenty years? Go online and listen to what a patient has to say.



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## Successfully Hiring Health IT Talent

For healthcare providers around the world, the past decade marked a definite transition from patient information stored on paper to a reliance on electronic health records. Organizations that manage to recruit and retain the brightest minds in IT will keep a competitive edge. Learn strategies how to attract and retain skilled IT staff in our online magazine.





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# hotos: Maciej Krawczyk

## Behind the Automation: How Fürst Medisinsk Laboratorium Transformed their Operations

For Havard Selby Ebbestad, CEO of Fürst Medisinsk Laboratorium in Oslo, Norway, identifying the best possible track design and smooth project implementation were critical parts of the organization's move to total lab automation. Visit us online and discover how workflow consulting, data-driven design, and comprehensive transition planning helped transform the largest private reference lab in Scandinavia.



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### **Joining Forces for Security**

Cybersecurity in healthcare is a growing concern. Faced with an increase in cyberattacks, healthcare systems across the globe will have to spend billions in the coming years to protect healthcare delivery. Read more online in an interview with Marc Rose, head of the Cyber-Health program at Siemens Healthineers.



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https://www.csoonline.com/article/3252343/cyber-attacks-espionage/ why-healthcare-cybersecurity-spending-will-exceed-65b-over-the-next-5-years.html



The busy Irchel Campus at the University of Zurich.

#### Speaking of collaboration ...

# The Next Generation of Scientists Speaks

In today's world, scientists of different fields need to work together – for their own success as well as for their patients' well-being. PhD programs, which provide an existing network, can facilitate this. Students in Zurich tell us what they think the future holds for them.

Text: Santina Russo | Photos: Raphael Zubler

istorically, many scientific disciplines were isolated. Medical doctors were barely connected to experimental researchers; lab diagnostics mainly provided services for other specialists, but were not involved, in the treatment of patients. In recent years, this dynamic has changed and will continue to do so, if we want to provide the best care for individual patients. Diagnostics is only one of the vital steps on the way to personalized medicine. Sharing knowledge with scientists from different fields is fast becoming indispensable.

This need to connect and collaborate is reflected in the training of young clinicians in graduate schools. In Central Europe, Switzerland for instance, there is not a long tradition of graduate programs; the idea was brand-new only 15 years ago. Now graduate programs like the Life Science Zurich Graduate School are an immense asset to students and principal scientists, says Susanna Bachmann.

Bachmann is the coordinator of the molecular life sciences program, one of 18 programs at the graduate school, a joint initiative of two leading academic research centers in Switzerland: ETH Zurich and the University of Zurich. Not only does the program provide principal scientists with an international pool of talented students to pick from; it also stimulates bottom-up collaboration, says Bachmann.

The students are endowed with an existing interdisciplinary network. There is a mentoring program, scientific meetings, retreats, company visits, and courses teaching transferable abilities such as communication skills and knowledge transfer. In these settings, the students can easily meet and learn about their respective projects – and establish new relationships and collaborations that transfer and enhance the research groups and encourage transfer between them.

With more than 530 principal investigators and over 1,600 PhD students benefiting from the program, it has grown into one of the largest graduate schools in Europe. We spoke with six students from five different countries. They reveal their passion for research, the necessity of collaborating with others, and what improvements are needed in communication and resources between disciplines in the future.

**Santina Russo** is an independent science journalist based in Zurich, Switzerland.



Name: Simon Deycmar Initial education: Biomedicine

From: Austria

Specialization: Proton radiotherapy

"I participate in a program of 14 PhDs, organized in seven institutes. It's an incredible opportunity to really collaborate. To see all the different mindsets and all the different projects, because we had nothing in common besides radiating cells. We are at a stage in science that we are so specialized that you cannot be the universal scientist anymore. I can tell them how to put protons in the patient for nuclear therapy, but then there's a chemist, a biologist, and a clinician – all working on the same patient.

We need to close the gap between industry and academia. Industry benefits from academic research, so we should establish symposia to assemble researchers, physicians, and funders; they need to sit together in the same office to have a close connection."



Name: Undine Rulle

Initial education: Molecular biology

From: Latvia

Specialization: Molecular biology

"I am part of a collaboration between 16 clinical centers in Europe and the U.S., which aims to validate diagnostic stainings. I also aided in the development of a portable diagnostic device. The company needed to know whether or not the machine is able to stain potential cancer tissue any better than the one that is now used. So, we help them to test it. We needed to involve computerized methods to help validate the results. We began five years ago and we are currently working with the model that they are going to produce.

It gives you a slide in 15, 20 minutes approximately. The one that they use now could take two hours to stain tissue. The company got information from the group on how to make a better product, and we got to use something that is a lot faster and as good, or even better with the results than what we would have normally."

"I'm part of a group working with the long-term goal of vaccine development for HIV. We study the immune response in individuals who are able to produce antibodies that can neutralize several HIV subtypes. Our lab works on how or why only some people develop these antibodies. We use samples from plasma and cells from the Swiss HIV Cohort Study, a database and biobank of people living with HIV. They form the basis of a lot of our work.

In terms of healthcare, I see a huge difference in the availability of resources in India versus in Germany and Switzerland. It's a common theme with infectious diseases – the places that have a high prevalence of infections don't get the resources required. The trend is improving overall in terms of life expectancy, in terms of access to healthcare, education, things like that worldwide. It's just that some places are growing more slowly than others, but the question is: How do you accelerate it as much as possible in the now?"



Name: Harini Subbaraman

Initial education: Microbiology and immunology

rom: India

Specialization: Institute of Medical Virology



Name: Stephen Isringhausen

Initial education: Molecular biotechnology

and biomedicine **From:** Germany

**Specialization:** Oncology and hematology

"I'm excited about merging technology with AI in diagnostics. I'm looking at chronic virus infections and how they can affect blood stem cells. The blood stem cell usually is in the bone, and we use flow cytometry and imaging in our lab. There are a lot of people who don't have the expertise in this specific field of bone imaging, so quite frequently we get to collaborate with different departments.

I am a huge fan of collaborations because you get to know different topics, maybe get involved in a different project. We have a monthly joint immunology meeting. It's rather broad, so you get access to information that you didn't know before, but it's still immunology."



Name: Cheng Guang Wu Initial education: Cancer biology

From: China

Specialization: Pathology

"I'm doing big data analysis – bioinformatics work in cancer immunology. Most patients with late-stage lung cancer tumors will experience Stage IV disease with malignant pleural effusion. There normally is only a three to six month survival rate. Through data and image analysis I can say how long the patient will probably live.

You have data scientists, you have biologists, you have doctors; these three groups can do more together, but you need to talk with each other, to translate the data and create a common language. This will be the trend. You cannot be independent of data interpretation and data analysis in medicine today."



Name: Johanna Wagner

Initial education: Biochemistry and molecular biology

From: Germany

Specialization: Department of Quantitative Biomedicine

"I analyze millions of cells from 144 breast cancers with mass cytometry. This method enables us to quantify dozens of different proteins at the single-cell level. We see that each breast cancer is unique, which might explain why some cancer patients respond well to treatment and others not. A 'one-size-fits-all' treatment approach is insufficient. We show that the detailed analysis of all cells in cancer can enable a more precise patient classification with impact on prognosis and treatment options.

Our research is only possible because patients and hospitals collaborate with us, such as the Patients' Tumor Bank of Hope. For the complex data analysis, external machine learning experts teamed up with us. To launch clinical trials based on our findings, an industry partner is needed."

#### Local Contact Information

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#### **Responsible for Content**

Matthias Krämer, PhD

#### Editor-in-Chief

**Editorial Team** 

## **Doris Pischitz**Monika Demuth, PhD

Stephanie Scharff Helen Bär Kathrin Schindler Kathryn McCollough

#### Project Management Nadine Meru, PhD Pia Schönsteiner

Marianne Heinisch Klaudija Ivkovic

#### Journalists

Garry Barker
Helen Bär
Linda Brookes
Philipp Grätzel von Grätz
Justus Krüger
Swati Prasad
Diana Smith
Janine Stephen
Santina Russo

#### Photographers

Walther Appelt Christiane von Enzberg Philip Frowein Hans Sautter Anna Schroll Peter Sierigk Raphael Zubler

#### **Photo Contribution**

Getty Images Science Photo Library / SciePro

#### Infographic

Jens Amende

#### Illustrations

Patricia Tarczynski

#### Copy Editing

Sheila Regan, Jen Metcalf UNIWORKS, Erlangen, Germany

#### Text & Photographic Contribution

Primafila AG, Zurich, Switzerland/Primafila Correspondents independent Medien-Design, Munich, Germany

#### **Editors Primafila Zurich**

Viviane Egli, PhD Simon Froehling

#### **Editors Primafila New York**

Roman Elsener Leane Clifton

#### **Art Direction**

Horst Moser

#### **Photo Editor**

Tanja Siegel

#### Layout

independent Medien-Design, Munich, Germany Mathias Frisch Hassân Al Mohtasib

#### **Production and Prepress**

Clemens Ulrich, Siemens Healthcare GmbH

#### Printer

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## Speaking of collaboration...

#### What do Siemens Healthineers think?



**Partha Ghosh, MD,** Clinical Marketing Advisor Molecular Imaging

"Lab diagnostics, radiology, and molecular imaging have always been synergistic. To progress the collaboration between lab diagnostics and molecular imaging, there should be easy access to and a display of lab-diagnostic information – including blood and urine tests, histopathology, microbiology, and genomics data – during the review and reporting of imaging studies. This solution is highly desirable as lab diagnostics may provide vital information for combined analysis in current research areas like PET, CT, and MR radiomics. One example: ApoE genetic profiles and cerebrospinal (CSF) amyloid and tau concentrations for reporting amyloid PET and MR results in dementia imaging. Another: prostate-specific antigen (PSA) histories, including doubling time along with histopathology for use alongside PSMA PET/CT reporting."



Monika Demuth, PhD, Editor for Diagnostics

"For me, health and quality of life are the most important assets. As a potential patient, I would like all involved parties to cooperate effectively should an illness be suspected or during the follow-up of a disease. Because nothing would be worse in such a situation than uncertainty. In such a case, I could only benefit from an intensive exchange between my attending physician and his or her diagnostically active colleagues in order to obtain a rapid, comprehensive, and clear diagnosis along with information for the safest possible treatment."



**Michael Heinold,** Managing Director Laboratory Diagnostics Germany

"The so-far untapped potential in lab diagnostics lies in digitalization. Connecting our lab data with other diagnostic data sources allows both a more effective and efficient diagnosis."



**Derek McIver,** Digital Marketing Manager Diagnostics

"Where about 70 percent of medical decisions are made based on lab test results, the potential for lab diagnostics to collaborate with other clinical specialties is tremendous. Lab tests are so often the beginning of a patient's journey, and are used throughout it to monitor his or her well-being. So patients who are managing conditions and living the healthiest lives they can, need reliable results to help them measure their progress."

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Siemens Healthineers Headquarters

Siemens Healthcare GmbH Henkestr. 127

91052 Erlangen, Germany Phone: +49 913184-0 siemens-healthineers.com