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I³lung

EU launches lung cancer research initiative

This summer, the European Commission launched I³lung, a new research initiative as a part of Horizon Europe, the EU's research and innovation program. This research initiative aims to create a cutting-edge, decision-making tool to help clinicians and patients select the best lung cancer treatment based on each patient's specific needs and circumstances.

'It's all about using artificial intelligence (AI), particularly deep and machine learning, to analyse a host of available information such as clinical baseline, radiomics, and the biological characteristics of the tumour,' said Arsela Prelaj, a cancer specialist at the National Cancer Institute of Milan, Italy. She is also a CEO and one of the coordinators for the I³Lung project.

The I³lung initiative brings together 16 international partners from Germany, Belgium, Denmark, Italy, Sweden, Switzerland, the US, and Israel. I³lung and its partners will have a timeframe of five years and € 10M to turn their project into a tangible tool to address a primary unmet clinical need in the field of lung cancer.

Immunotherapy: A powerful, but flawed treatment strategy

Lung cancer is the second most common form of cancer worldwide after breast cancer. With a case distribution of 85% for non-small-cell lung carcinoma (NSCLC) and 15% small-cell lung carcinoma (SCLC), lung cancer is the leading cause of mortality in men over 40 and in women over 59 years of age.This equates to 1.8 million deaths worldwide, of which 370,000 are in Europe. The advent of immunotherapy has revolutionized the treatment of patients. It has become the first-line therapy for metastatic NSCLC tumours lacking a targetable driver mutation. Today, immunotherapy is used either as monotherapy or in combination with routine chemotherapy.

However, only 30% to 50% of patients experience a long-term response to immunotherapy. 'Indeed, to this day, programmed death-ligand 1 (PD-L1) remains the only biomarker with a satisfactory record of prediction of a patient's response to immuno-oncological agents,' said Prelaj.

Machine learning to overcome current cancer treatment limitations

'The challenge lies in developing a new generation of tools, capable of simultaneously analysing the vast amount of complex data relating to tumour biology,' said Filippo de Braud, head of the Department of Oncology and the Medical Oncology Clinic at the National Cancer Institute, Milan. The I³lung initiative plans to develop a platform for Europe and beyond to capitalize on these new tools for coping with the complexity of available data regarding lung cancer biomarkers.

Retrospective analysis of 2,200 patients treated with first-line immunotherapy between 2012 and 2021 at multiple centres will provide baseline clinical, radiomic, and biological tumour characteristics. 'In addition, enrolling 200 new patients in a prospective study will generate new multi-omic biological data, including tumour mutational burden, circulating immune biomarkers profiling, digital pathology, gut microbiome, radiomics, and other multi-omics approaches,' said de Braud.

Additionally, a psychological study will also be conducted that will incorporate patient experience and preferences to contribute to developing a shared decision support tool. Patients' tumours will be subjected to state-of-the-art genomic analysis.

Six clinical cancer centres based in Italy, Germany, Greece, Spain, Israel, and the United States are involved in these data collection processes.

Novel integrated AI-assisted data storage

The final goal is the construction of a novel integrated AI-assisted data storage and elaboration platform backed by reliable, comprehensible AI methodology. 'It will ensure accessibility and ease of use for healthcare providers and patients alike,' said De Braud.

Four institutes and med-tech companies from Italy will be pivotal to the success of I³lung. The Polytechnic University of Milan and its spin-off, ML cube S.r.l., specialists in computer systems design, will be jointly responsible for the implementation of this new generation of the platform. The Mario Negri Institute for Pharmacological Research will analyse patients' tumour metabolism. The European Institute of Oncology will be responsible for evaluating the psychological impact of this method on patients and doctors alike.

This individualized approach will improve the outcome of therapy for patients by better matching them and their specific situations to the different treatments available. 'If successful, the approach presented by I³lung could soon justify an initial pilot study, which could expand on the project and attempt to apply the tools and techniques developed to all forms of cancer where patients are candidates for immunotherapy in routine practice,' said Prelaj. ■

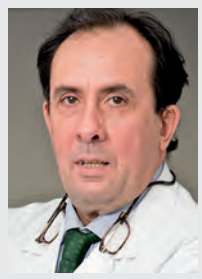
Report: Bernard Banga

16 partners in I³lung consortium

1. Fondazione IRCCS Institut Nationale dei Tumoru, Italy
2. Politecnico di Milano, Italy
3. Istituto di Ricerche Farmacologiche Mario Negri, Italy
4. Istituo Europeo di Oncologia, Italy
5. ML S.r.l Cube, Italy.
6. LungenClinic Grosshansdorf GmbH, Germany
7. Universitätsklinikum Hamburg-Eppendorf, Germany
8. Vall d'Hebron Institute of Oncology, Spain
9. Medica Scientia Innovation Research, Spain & USA
10. Metropolitan Hospital, Greece
11. Shaare Zedek Medical Center, Israel
12. Katholieke Universiteit Leuven, Belgium
13. The Swedish Institute for Health Economics, Sweden
14. The University of Chicago, USA
15. Aalborg Universitet, Denmark
16. Lung Cancer Europe Bern, Switzerland

Arsela Prelaj

Arsela Prelaj is a cancer specialist at the National Cancer Institute in Milan, Italy, and one of the coordinators for the I³lung project. She is a member of the European Society for Medical Oncology and of the International Association for the Study of Lung Cancer.



Filippo de Braud

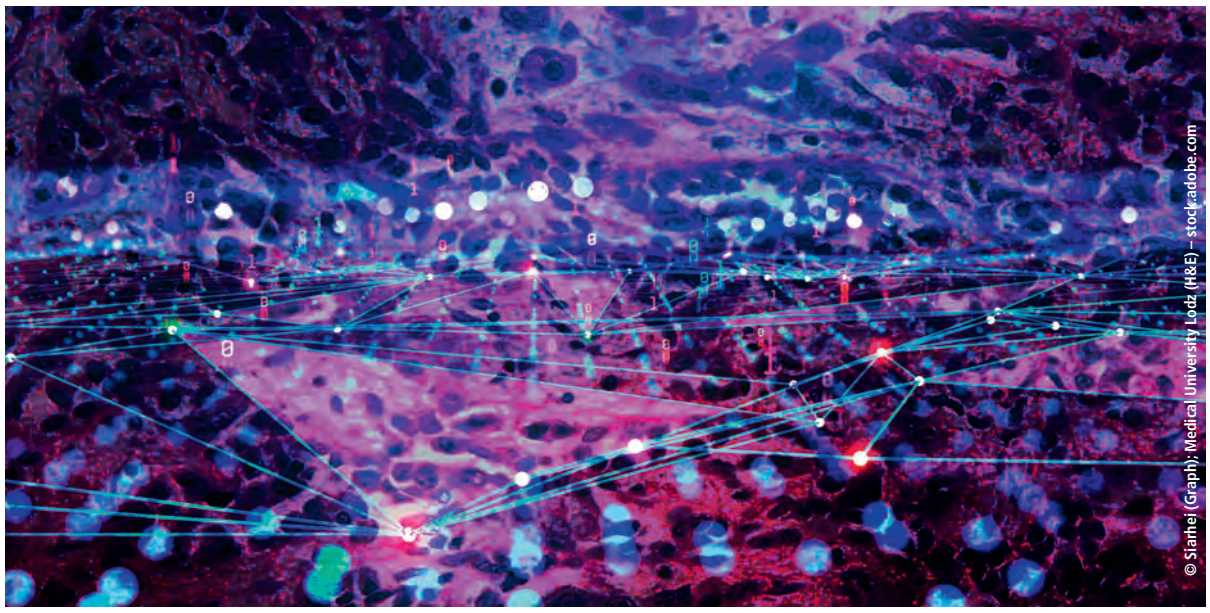
Filippo de Braud is director of the Department of oncology and the medical Oncology Clinic at the National Cancer Institute in Milan, Italy. He is a member of the Society for Immunotherapy of Cancer and a member of the European Society for Medical Oncology.

CONTENTS

AI provides prognostic information

Next-generation deep learning models predict cancer survival

Deaths from cancer are currently estimated at 10 million each year worldwide. Conventional cancer staging systems aim to categorize patients into different groups with distinct outcomes. 'However, even within a specific stage, there is often substantial variation in patient outcomes,' Markus Plass, academic researcher from the Medical University of Graz, Austria, explained to European Hospital. Hence the rapid growth of Artificial Intelligence (AI), machine learning and deep learning in providing novel prognostic information that is not captured in current staging guidelines.



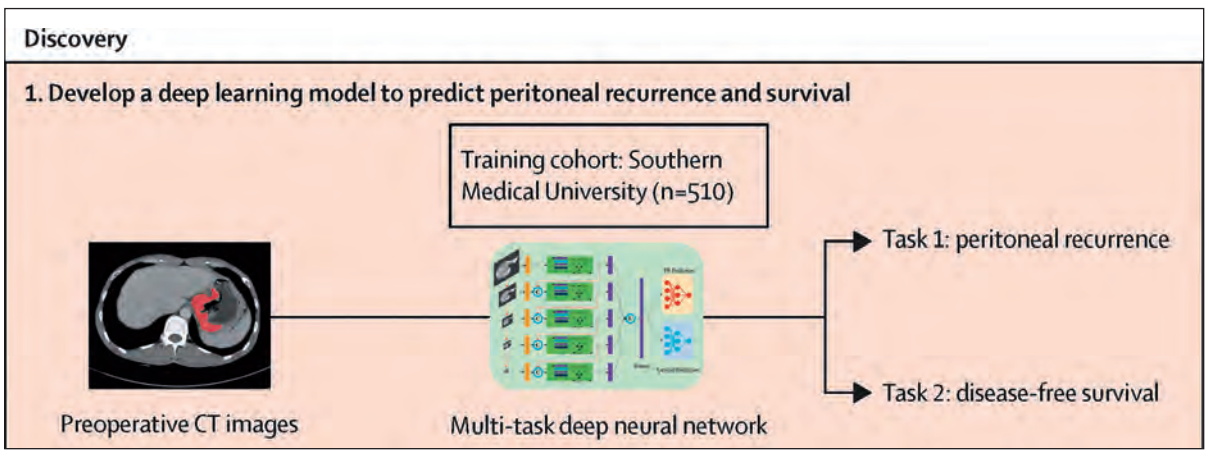


Image source: Jiang et al., Lancet Digital Health 2022 (CC BY 4.0)

Deep learning, a subdivision of machine learning, uses convolutional neural networks to devise informative representations of raw input data automatically, without requiring manual feature engineering. 'This is particularly useful for image segmentation and classification in histology slides,' said Athena Davri, biologist at the Department of Pathology in the Faculty of Medicine, School of Health Sciences, University of Ioannina in Greece. Currently, histopathology examination of tissue remains the 'gold standard' for diagnosing colorectal cancer, the second most common cancer in women and the third most common in men. However, routine pathology lab tests are taking up a lot of time and effort, due to the high incidence of this type of cancer. Furthermore, the worldwide shortage of pathologists has led to delays in diagnosis. AI models initially made it possible to automate and speed up the work before integrating parameters from the tumour ecosystem.

So much so in fact, that in 2022 alone, Davri's team has listed, in a systematic review published in August, around a hundred scientific articles devoted to deep learning on histopathology images for diagnosing colorectal cancer. According to this systematic review, 'algorithms based on deep learning have the potential to assist with diagnosis, identify histological features relating to prognosis and associated with metastasis, and assess the specific components in the tumour microenvironment,' said Davri.

Contextual histopathology features from whole-slide images

Today, the revolution in prognosis is coming from the relationship between deep learning and whole slide imaging. Also known as virtual microscopy, whole slide imaging refers to scanning a complete microscope slide and creating a single high-resolution digital file. A typical whole slide image may contain 100,000×100,000 pixels. Analysing and viewing whole slide images is often constrained by computer memory or screen size. A common workaround for these issues is capturing many smaller, high-resolution image tiles or strips, which are then stitched together to create a full image of a single histological section. This works because whole slide scanners take separate images of each field of view across the entire slide at high speed. The images acquired separately are then stitched together during the scanning process to generate a single digital image at full resolution.

Many experts agree that machine learning is the future for digital pathology. A Chinese team from the Sun Yat-sen University Cancer Center, Guangzhou, affiliated to the laboratory of Precision Medicine for Gastrointestinal Tumors at Nanfang Hospital, and US scientists from the Department of Radiation Oncology at Stanford University School of Medicine in California, have designed a multitask deep learning platform for simultaneously predicting peritoneal recurrence and disease-free survival using preoperative CT images. 'We trained it using a retrospective, multi-institution study on 2,320 subjects and evaluated the prognostic accuracy of the model as well as its association with chemotherapy response,' said Prof Guoxin Li from the Department of General Surgery & Guangdong Provincial Key Laboratory of Precision Medicine for Gastrointestinal Tumor.

Findings were published in The Lancet Digital Health in May 2022. When informed by the AI model, clinician performance was significantly enhanced for predicting peritoneal recurrence. Additionally, the AI was able to identify which patients with stage II and stage III gastric cancer were most likely to benefit from adjuvant chemotherapy.

Multimodal deep learning close to clinical routine

All forms of cancer stand to benefit from the prediction capabilities of machine learning models. One team, from Seoul National University in the Republic of Korea, is applying the machine learning approach to the analysis of whole-slide images of kidney, breast, lung and uterine cancers. In August, the researchers tested their deep learning graph on 3,950 patients with these four types of cancer. 'Deep graph neural networks that derive contextual histopathology features from whole slide images may aid diagnostic and prognostic tasks,' said Prof. Kyung Chul Moon from the Department of Pathology at Seoul National University College of Medicine.

Currently, no AI-based models are being used in clinical practice. However, multimodal approaches linking biology, histopathology imaging and gene expression are bringing experimental deep learning models closer to routine clinical application. In 2021, teams from the Department of Urology and Pediatric Urology, the Department of Diagnostic and Interventional Radiology, and the Institute of Pathology all at the University Medical Center in Mainz, Germany, did develop and evaluate a multimodal deep learning model for prognosis prediction in clear-cell renal cell carcinoma (ccRCC). This disease is the most common type of kidney cancer with more than 175,000 associated deaths each year. In contrast to other tumour types, there is no clearly defined set of biomarkers used in clinical routine. Clinical management of ccRCC usually involves various disciplines including urology, radiology, oncology, pathology, and more besides. 'This results in a vast amount of medical data on each patient, such as CT/MRI scans, histopathology images and other clinical information,' explained Prof Axel Haferkamp, Director of the Department of Urology and Pediatric Urology.

There are several clinical tools for prognosis prediction in ccRCC, such as the UCLA Integrated Staging System (UISS) or the International Metastatic Renal Cell Carcinoma Database Consortium risk model.
'But while prognostic clinical nomograms might be helpful, they can be cumbersome to use and often only incorporate a selection of the available information – both of which potentially limit their performance,' said Peter Mildenberger, radiologist, senior consultant and associate professor at the Department of Diagnostic and Interventional Radiology in Mainz. Their multimodal deep learning model showed great performance in predicting the prognosis of clear-cell renal cell carcinoma patients, with a mean accuracy of 83.43%. Furthermore, this latest tool's prediction was an independent prognostic factor which outperformed other clinical parameters.■

Report: Bernard Banga

Deep learning-based algorithm for Papillary thyroid carcinoma

According to the World Health Organization, the tall cell variant (TCV) is an aggressive subtype of papillary thyroid carcinoma (PTC) featuring at least 30% epithelial cells two to three times longer than they are wide. In practice, applying this distinction is difficult, leading to substantial variations between observers. 'That's why we are developing and training a deep learning algorithm using supervised learning to detect and quantify the proportion of tall cells (TCs) in papillary thyroid carcinoma,' explained Sebastian Stenman, researcher from the Institute for Molecular Medicine, and the Department of Pathology at the University of Helsinki, Finland.

In summer 2022, his research team tested it on an independent data set, and further validating it on an independent set of 90 papillary thyroid carcinoma samples from patients treated at the Hospital District of Helsinki and Uusimaa (HUS) between 2003 and 2013. The Finnish scientist compared the algorithm-based tall cell ratio to independent scoring by a human investigator and looked at how those scores were associated with disease outcomes.

The results published revealed that the deep learning algorithm detected tall cells with a sensitivity of 93.7% and a specificity of 94.5%. In the validation set, the deep learning algorithm tall cell scores correlated with a diminished relapse-free survival. 'We showed that the DL-based algorithm was better than the human observer in identifying tall cell variants,' said Stenmann. The algorithm could prove useful as a clinical tool for pathologists when evaluating PTC samples and could potentially significantly improve the consistency of TCV case assessment. So far, no such algorithm has been described.

Detecting several different diseases

Multiplex diagnostics: next-generation techniques for new challenges

With the rise of syndrome-style infections, co-infections and the current antimicrobial resistance challenges, the need for multiplexed diagnostics is now more important than ever. Multiplexing is the process of simultaneously detecting or identifying multiple biomarkers in a single diagnostic test, which can be valuable for several different types of diseases.

For example, pharmacogenomic studies in patients with cardiovascular disease have indicated that the presence of polymorphisms affects a patient's response to various drugs. Therefore, the multiplex detection of relevant biomarkers not only provides insight into the pathophysiology of cardiovascular disease, but also serves as a guide for the most efficient treatment option.

Infectious disease is another area where multiplexed diagnostics prove extremely valuable. Most infectious diseases, such as urinary tract infections and respiratory infections, have multiple causative pathogens, but the resulting symptoms do not indicate which in particular. On the other hand, different types of infections that have shared symptoms could be misdiagnosed or incompletely diagnosed. For example, SARS-CoV-2 and influenza A or B present with many of the same symptoms and clinical features, types or location.

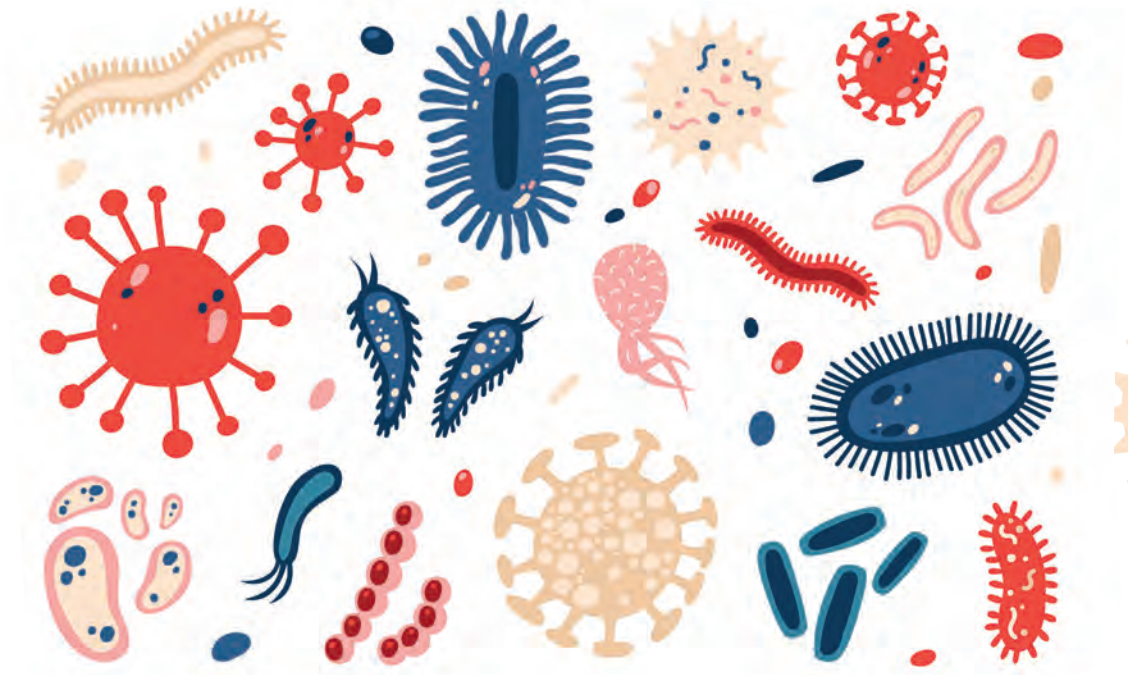
The World Health Organization further clarifies the standards of testing processes with a set of criteria under the acronym ASSURED – for Affordable, Sensitive, Specific, User-friendly, Rapid and Robust, Equipment-free and Deliverable to end-users. Advances in the digital age have led to a revision of the ASSURED criteria to REASSURED, with the addition of 'RE' for Real-time connectivity. Here, multiplex test analyses and digital pathology with AI-powered technologies are merging as clinically enabling companion diagnostics.

LFA, ELISA and PCR used routinely in multiplex diagnostics

Currently, clinically available multiplex diagnostics are aimed at the detection of protein or peptide biomarkers as well as nucleic acid testing. Lateral flow assay (LFA) was the first technology used routinely to detect a range of protein or peptide biomarkers in human samples – such as blood, serum, saliva and urine – for clinical diagnosis. This original test meeting the WHO ASSURED criteria uses a variety of detection techniques, including fluorescent, chemical, or colorimetric immunoassays. Due to advances in technology, some immunoassays could be adapted to the point-of-care setting for multiplex peptide and protein biomarker detection. 'While lateral flow assays have lower sensitivity than molecular diagnostic tests, they are rapid and relatively cheaper to fabricate compared to other diagnostics,' said Travis Schlappi, assistant professor specializing in chemical engineering for diagnostic medical devices at Keck Graduate Institute, Pasadena, California.

The second technology used in routine practice for multiplex diagnostics, enzyme-linked immunosorbent assays (ELISA), is a highly sensitive method for detecting protein and peptide biomarkers. However, ELISA is very prone to external interference, which poses challenges to developing a multiplex test. This is overcome by spatial multiplexing approaches, such as wells and microarrays.

Regarding nucleic acid testing, polymerase chain reaction (PCR) is the gold standard amplification method for molecular diagnostic assays in clinical use. 'However, multiple temperatures are required to amplify the target. Equipment parts that can perform thermal cycling must



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therefore be used,' said Schlappi. So, there is need for stringent optimization of reaction conditions and parameters in order to achieve a multiplex process.

Multiplex Diagnostics in Research

Although there are currently around a dozen companies as key players in multiplex diagnostics, there are many multiplex immunoassays (MIAs) under development and only a few have so far been commercialized. One team, from the Department of Biomedical Engineering at the University of California, has demonstrated an approach using a smartphone camera for reading ELISA-on-a-chip assays. This team designed a cell phone-based handheld microplate reader that uses optical fibres to transmit data from ELISA plates to a cell phone camera for diagnostics at the point of care.

Similarly, researchers from Kyung Hee University, Yongin, South Korea, have been looking into an innovative multiplexing method for nucleic acid testing. In 2022, they published in Biosensors and Bioelectronics details of a rapid multiplexed molecular diagnostic system, dubbed a flow genetic analysis system (FGAS), capable of conducting quantitative detection of nucleic acids. FGAS is portable and battery powered, making it suitable for low resource settings. It connects to a smartphone, used for fluorescent imaging. This new system represents a fully automated multiplex molecular diagnostic device for respiratory tract infections.

The platform is based around reverse transcriptase polymerase chain reactions (RT-PCR) and is capable of automated sample-to-answer analysis with a turnaround time of 3 hours 20 minutes, using centrifugal microfluidics. 'Our diagnostic device, based on the Internet of Things (IoT), is accompanied by an integrated microfluidic chip capable of running a multiplexed reverse-transcriptase LAMP,' said Huynh Quoc Nguyen from the university's Department of Chemical Engineering.

Future lab-on-a-chip and lab-on-a disc platforms

The development of micro- and nanofluidics has inspired the emergence of several miniaturized platforms, such as lab-on-a-chip and lab-on-a-disk. 'These platforms deliver the capabilities of molecular-scale sensitivity on low-cost and rapidly fabricated devices,' said Travis Schlappi. However, adopting these platforms into clinical diagnostics is yet to happen. Droplet microfluidics and microarray are some of the techniques used to achieve multiplexing using digital PCR (dPCR). While very promising, the development and commercialization of microfluidic platforms are held back by the high cost and complexity of manufacturing on a large scale.

Could Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR) offer a solution? In recent years, a number of studies have migrated towards the application of CRISPR/Cas12a systems for multiplex molecular diagnostics. CRISPR/Cas12a is a new RNA guided endonuclease that has recently been harnessed as an alternative genome editing tool. A team from the Department of Biological Engineering at MIT in Cambridge, Massachusetts, has proposed a high throughput multiplex nucleic acid detection microarray system. In their 2021 publication in Nature, the developers describe the system as potentially being the ultimate point of care diagnostic device, with high sensitivity and specificity, combined with high throughput, once integrated with upstream sample preparation and concentration stages.

Rapid and highly sensitive approach for multiplex somatic fusion detection

Somatic gene translocations are key to making an accurate diagnosis in many cancers, including many sarcomas in children. Currently available molecular diagnostic approaches to identifying somatic pathognomonic translocations 'have limitations such as minimal multiplexing, high cost, complex computational requirements, or slow turnaround times,' said Samuel Abou, child cancer specialist at the Gustave Roussy Institute, Villejuif, France, and Brian Crompton, laboratory researcher specializing in the genomics of sarcomas at the Dana Farber Cancer Institute (Harvard Medical School, Boston, Massachusetts). This team has developed a new fusion detection assay optimized to mitigate these challenges. Their highly sensitive multiplexed digital PCR-based approach can identify the gene partners of multiple somatic fusion transcripts. This assay was validated for specificity with cell lines and synthesized DNA fragments. Assay sensitivity was optimized using a tiered amplification approach for fusion detection from low input and/or degraded RNA. The assay was then tested for the potential application of fusion detection from formalin-fixed paraffin-embedded (FFPE) tissue and liquid biopsy samples.

According to results published in March 2022 in Modern Pathology, this multiplexed PCR approach was able to accurately identify the presence of seven different targeted fusion transcripts, with turnaround times of 1 to 2 days. The addition of a tiered amplification step allowed the detection of targeted fusions from as little as 1 pg of RNA input. 'We have also demonstrated that the assay could easily be adapted for additional fusion targets,' said Abou. This novel assay detects multiple somatic fusion partners in biological samples with low tumour content and low-quality RNA in less than two days. The inexpensive assay could be applied to surgical and liquid biopsies, particularly in places with inadequate resources for more expensive sequencing. ■

Report: Bernard Banga

Lab-on-a-chip

The ongoing coronavirus pandemic caused by SARS-CoV-2 and its variants is still a major public safety issue worldwide. Large-scale vaccination and sensitive detection are vital for preventing the spread of Covid-19 infection. To this end, teams from the Hospital of Guangzhou Medical University, and from the Department of Biomedical Engineering, Southern University of Science and Technology, Shenzhen, China, have established multiplexed lab-on-a-chip bioassays for testing antibodies against SARS-CoV-2 and its variants.

'Virus neutralization assays that can measure neutralizing antibodies in serum are vital for determining vaccine efficacy,' said Prof Yong Xia, Department of Clinical Laboratory, Third Affiliated Hospital of Guangzhou Medical University. Compared with ELISA, their method demonstrates a low consumption of sample and reagents (10 µL), a low threshold for detection (0.08 ng/mL), a rapid sample-to-answer time (about 70 min), and multiplexed ability (5 targets in each of 7 samples in one assay).

Results were published in 2022 in Analytical Chemistry. 'We can also ramp up the throughput as needed,' said Prof. Xingyu Jiang. His team performed a plaque reduction neutralization test (PRNT) for all volunteers. Compared with PRNT, their assay is fast, accurate, inexpensive, and multiplexed with multiple-sample processing ability, which is good for large-scale serodiagnosis and vaccine evaluation.

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Precise therapy

Molecular Tumour Board to support better decision-making for patient care

As more genomic alterations become targets for therapy, health institutions and hospitals are creating specialist Molecular Tumour Boards to support better decision-making for patient care. This evolving team, and its role, was highlighted in a presentation at the 34th European Congress of Pathology in Basel, Switzerland.

Molecular tumour boards should include pathologists, radiologists, molecular geneticists pharmacologists and clinicians.

Professor Fernando Schmitt, who is Head of the Molecular Pathology Unit (IPATMUP) in Porto, Portugal, told delegates that over the last decade several new substances have been launched to treat solid tumours, with some receiving approval for multiple indications. With the advance in tumour molecular biology strictly associated with the need to include more molecular analysis in tumour diagnosis, that has seen the concept of the Molecular Tumour Board (MTB) – first developed in Michigan in 2011 – play an increasingly pivotal role in the field, with pathologists as the pillars of these boards alongside clinicians. With 40% of the oncology pipeline in Phase I trials, he forecasts major expansion of molecular targets over the next three to five years.

Adequate sample

Selection of an adequate sample for molecular analysis and understanding the performance of the genomic tests is paramount, enabling integrations of morphology with molecular information, said Schmitt. He further underlined the importance of pathologists' expertise in the acquisition and management of high-quality tumour samples. 'This is important because tumour sampling represents a crucial phase for any subsequent molecular analysis,' he explained.

Selection of the best samples has challenges and can be problematic where there are central laboratories, but he stressed the need to obtain good quality, and recent, samples and enable triage before sending them for more molecular analysis.

Next-generation sequencing

With samples of sufficient quality, he said NGS (next-generation sequencing) can be utilised to deliver precision medicine in oncology, adding that 'pathology is essential for precision medicine.'

While 'uniplex' or 'multiplex' analysis has a valid role, he indicated that NGS has advantages for analysis of a large number of genes, has good sensitivity, and is a modern tool that works well in pathology. Within the MTB arena, specific scales have been designed and approved for assessing samples for clinical actionability. And while a good quality sample ensures the material is suitable for molecular analysis, it may also deter oncologists from migrating to liquid biopsy. 'We know liquid biopsy is a good compliment for tissue analysis but it is not a replacement for tissue analysis,' said Schmitt.

Multidisciplinary council

The MTB expands the possibilities for genetics-guided therapy, but he emphasised the need to bring the required expertise together in the MTB 'to ensure optimal care in an increasingly complex biomarker landscape.' The aim of MTBs is to define the most appropriate strategies for genomic profiling and the correct interpretation of the results obtained from the molecular analyses of tumours. MTBs can and include specialitsts ranging from pathologists, radiologists, molecular geneticists to pharmacologists and clinicians. Reports should contain patient identification, and results that are concise and clear.

Rare tumours

The MTB allows integration of modern molecular diagnostic data and discussion of complex cases; it offers more precise and rational therapy recommendations; identifies and optimizes patients access to clinical trials; guides patient testing and treatment allocation practices; and promotes continuous medical education on emerging biomarkers.

'It is a multidisciplinary decision-making platform aimed to improve patient outcomes by consensus and standardized procedures,' Schmitt added.

'So, in the end we will have a treatment decision, we can request alternative molecular profiling assays, we can decide for an off-label treatment, or enrol a patient in a specific clinical trial.'

While he emphasized that all tumours should be discussed MTBs are particularly valuable for rare mutations, rare tumours without available therapeutic options, gene alterations that are not reported as associated with drug response or resistant, patients with oncogene-addicted tumour, or tumours that do not show responsiveness to the available targeted therapies.

Treatment costs

Molecular guided therapy typically takes up around 6% of patient treatment costs, compared to hospitalization (34%) and drugs (60%). Schmitt also outlined the example of the POP-IPOP trial in Porto, looking at the challenges of broad molecular profiling such as timely access to results, access to the right drug at the right time, multiple potential actionable alterations in the same patient and of how to navigate the available evidence. ■

Report: Mark Nicholls

Fernando Schmitt

Fernando Schmitt is Professor of Pathology at the Medical Faculty of Porto University; he heads the Molecular Pathology Unit at IPATIMUP (Institute of Molecular Pathology and Immunology of the University of Porto), a Portuguese non-profit institution dedicated to health sciences research. Furthermore, he is Director of RISE Health Research Network; and general secretary and president-elect of the International Academy of Cytology.

UPCOMING EVENTS IN PATHOLOGY AND LABORATORY

3.-4. November 2022
16. International Conference on Advances in Clinical Chemistry and Laboratory Medicine, Amsterdam

7.-8. December 2022
9th Digital Pathology & AI Congress: Europe, London

9.-10. December 2022
16. International Conference on Laboratory Medicine and Pathology, London

6.-9. February 2023
Medlab Middle East, Dubai

9.-10. February 2023
Labquality Days, Helsinki

Regulatory challenges for AI-based diagnostics

Further IVDR changes: a step in the right direction, but…

New changes made to the timetable for the In vitro Diagnostic Medical Device Regulation (IVDR) across Europe could have a significant impact on manufacturers and users, an expert points out. While the extension of the transition period was a welcome step, other changes which were hoped for remain painfully absent.

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The transition period extension depends on the risk class of the device and only applies to existing, rather than new, devices. Professor Kurt Zatloukal, Head of the Diagnostic and Research Center for Molecular BioMedicine at the Medical University Graz in Austria, outlined the specific challenges for digital pathology and AI-based in vitro diagnostic devices (IVD). The transition period for these products, which are typically categorized as class C devices, has now been extended to May 2026.

Focus topic: updated IVDR timetable

Speaking at the 9th Digital Pathology and AI congress* in London in December, the expert aims to outline the impact of these changes as well as reflecting on the main developments in recent months. A focus topic will be on the European Commission's (EC) updated IVDR timetable, but lack of exemptions or weakening of requirements that had been anticipated by some medical colleagues at hospitals and university centres. 'The second point is that application of IVDR to innovative devices such as digital pathology and AI algorithms is a new field,' he pointed out, 'so everybody has to learn: manufacturers, regulatory bodies and also the users.'

Full IVDR compliance mandatory for new products immediately

Zatloukal explained that the extended transition period for those devices that are already on the market under IVDR was necessary both for manufacturers and notified bodies because of massive workload caused by additional efforts of IVDR, but also due to Covid-19. As cancer remains the most relevant field for many applications of digital pathology and AI, these products typically fall under the class C segment of devices in the higher risk bracket. Under the new timetable, their extension period now ends on May 26, 2026. 'That means there is now still some time for those already on the market to get recertification under IVDR, but not for the new ones,' the expert pointed out. 'This is a very rapidly developing field, and we expect many new products. For all these new products, IVDR applies fully already now.'

Lab-developed tests: balancing patient safety and access

IVDR now also applies to IVD tests manufactured by a health institution that are to be used in that institution, which are commonly known as lab-developed tests. For these devices, the general safety and performance requirements have to be met. This is a major challenge for a diagnostic laboratory, Prof Zatloukal said: 'One has to be aware of the consequences in case an industrial device is used outside of its intended purpose, which means it falls under the requirements of lab-developed tests.

'Here, I see a lack of information for users who make a diagnosis with such a device.' This will be particularly relevant with the rare diseases field, the expert added; since the market is not large – and therefore, not profitable – enough for commercial products, most diagnostics are performed through lab-developed tests.

Adapting to the new IVDR remains a complex undertaking for many affected parties, even though awareness of the issues has increased in the past year, Zatloukal finds. As the expected exemptions for using IVDR in a hospital or university complex did not come to pass, and the only significant change was the extension of the transition period, he sees this was a very clear message from the EC – 'that they do not want to weaken the requirements of IVDR.' While the underlying principle of IVDR is to improve patient safety, he warns that if the implementation prevents access to a certain diagnostic assay, that may also lead to some harm.

The need for dialogue remains

The new regulation remains particularly challenging for pathologists, the expert believes. Covering a wide range of diseases, they often take an individualised approach, with many diagnoses relying on lab-developed tests. 'Because simply no industrial product is available on the market,' he said. In the context of IVDR, when using an AI-based algorithm for diagnostic decision-making, the whole workflow has to be considered from tissue collection, staining, scanning, and the algorithm, as well as how the result is displayed to the pathologist, Zatloukal added.

While there is now some clarity because of the amendment published in December – with the extension of the transition period, the expert argues that there remains a need for dialogue of manufacturers, regulators and users to better understand how IVDR requirements are applied to the specific characteristics of digital pathology and AI algorithms.

* The 9th Digital Pathology and AI Congress takes place in London on December 7 & 8 and features more than 75 presentations given by a range of expert speakers from industry, academia and healthcare providers. The themes of the conference are: Digital Pathology – Implementation, Strategy, Technology & Applications; AI for Imaging and Digital Image Analysis; Computational Pathology and AI.
Additional sessions will cover Pharma/Biotech Case Studies as well as featuring Panel Discussion, Roundtables and Workshops. Keynote presentations will be given by David Wells, Basharat Hussain, Marilyn Bui and Anil Parwani. ■

Report: Mark Nicholls


Kurt Zatloukal

Kurt Zatloukal is Professor of Pathology and head of the Diagnostics and Research Center for Molecular Biomedicine at the Medical University Graz in Austria. His research focuses on the molecular pathology of metabolic liver diseases and cancer as well as molecular diagnostics and machine learning approaches for digital pathology and is in the development of standards related to molecular diagnostics.

Seven lessons

Integration of AI in the clinical workflow

In radiology, it is not about if but about when artificial intelligence (AI) will be used, said Professor Dr Tim Leiner of Utrecht University Medical Center at this year's European Congress of Radiology in Vienna. For all those who are new to AI, the Dutch radiologist gave an overview of the lessons he and his team have learnt so far.

And indeed Professor Leiner offered seven distinct and entirely practice-oriented lessons.

Lesson 1: Identify the use cases

'Identify the use cases. Artificial intelligence is not an end in itself; it is a means – the solution to specific problems. Focus on a problem which you want to solve. Ask yourself where the use of AI really makes a difference.'

Lesson 2: Set up a team of experts

'Set up a team of people with diverse expertise – among them obviously clinicians who contribute basic knowledge of the medical discipline in question. However, you also need healthcare IT and informatics specialists, e.g. PACS administrators. Moreover, I would recommend bringing AI experts on board since they can realistically assess the providers' claims and promises. In addition, a patient representative is a good idea. Many algorithms are mere 'black boxes' and the exchange with a patient representative can offer insights into patient psychology: some might feel uneasy about the technology's lack of transparecy and reject it outright.'

Lesson 3: Choose a platform

'Choose a platform that fits into your environment. Take into account the long-term perspective: the range of available applications will grow. In Utrecht, we tried to be as open as possible. We wanted a platform where we decide what's running on it, not the platform provider. It was crucial for us that the platform was able to process algorithms by different providers as well as the algorithms we will develop in-house.'

Lesson 4: Choose a test product

'After you have decided on a platform, choose a product that promises to be a good solution for your specific clinical problems.'

Lesson 5: Define criteria of success

'We recommend establishing specific criteria beforehand that define when the implementation of an application is considered successful. Think about the goals you want to achieve with the application, e.g. higher throughput, higher precisions, saving time, or decreasing costs.'

Lesson 6: Conduct a pilot project in the hospital

'Conduct a pilot project in your own institution. Never, ever buy an algorithm you did not test in your own clinical workflow. Don't rely on demos. Collect as much feedback as possible from radiologists and clinicians. The test should run over a longer period of time, at least a few weeks, preferably some months. Assess the success of the pilot project using the criteria you defined

before the test. If you don't do that you are setting yourself up for disappointment. Buy the algorithm only after a thorough assessment.'

Lesson 7: Implement smoothly

'When you are satisfied with the platform and the product, implement them smoothly. It is crucial to involve the users! Set up a team of 'ambassadors' who gathered experience during the pilot project and can thus answer questions during and after roll-out.'

In addition to offering these lessons, Professor Leiner briefly addressed the obstacles that have to be surmounted when introducing AI in radiology. He pointed out that many algorithms were developed on the basis of very few cases: 'Due to the General Data Protection Regulation and other privacy considerations the data sets are frequently small and biased. This is something we need to always keep in mind.' Professor Leiner's take-home message: 'The introduction of artificial intelligence in healthcare is difficult and hard work.' ■

Report: Michael Krassnitzer

I, Algorithm

The 3 laws of robotics for AI in radiology

Ethical considerations continue to fuel the discussion around artificial intelligence (AI).

When science fiction author Isaac Asimov devised a set of rules for robotics in 1942, little did he know how relevant they would still be 80 years later. The rules, or laws, famously featured in the novel 'I, Robot', state that:

- a robot may not injure a human being or, through inaction, allow a human being to come to harm;
- a robot must obey orders given by human beings except where such orders would conflict with the First Law; and
- a robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

These three laws could also apply to AI, suggested Federica Zanca, Founder at Palindromo Consulting. 'Radiologists should not trust an algorithm blindly and they should be aware of any issues related to the algorithm that have a negative impact on patient care,' she said. For example, some AI tools might be subject to what is called external drifting of the model: the data input may change over time and therefore models developed on limited sample sizes may be subject to degradation of the model performance over time. 'Most AI models today are locked,' Zanca said. 'They have been trained with specific data to get a certain output and are not learning from new data to adapt accordingly.'

FDA regulation

Solutions to remedy that situation are in the pipeline and the FDA has already worked on regulation to approve self-learning tools. However, radiologists need to beware of self-learning models turning against them and errors sneaking in that compromise the wellbeing of patients, she insisted. 'Quality assurance should be performed with each imaging medical device including AI software,' suggested Zanca. '

Gaspard d'Assignies, Co-founder and Director of the Medical Strategy at Incepto Medical, said that Radiologists need to know how to accept, reject or modify an algorithm. 'We need to understand how these algorithms are going to modify patient care. So we need prospective, real-life studies that compare reader performance of man with machine vs. man and machine alone over time.

What happens when humans use AI?

The central question that all these considerations should revolve around, he added, is: How can AI improve workflow and accuracy according to the clinical context? 'The design purpose must be very clear, and studies must be conducted to validate these improvements.' When creating an AI solution, a doctor should always be in the loop to check when the machine is right or not. 'We don't want a black box effect and we also must make sure that our algorithm is not biased and includes all the people it is supposed to represent,' he said.

One question, ten different values

This is where the second of Asimov's laws comes into play: AI should not obey the radiologist when he or she is wrong. 'If you asked a radiologist to do the measurement, you would possibly get ten different values. This may have consequences on treatment and the patient's life. The machine is doing much better, and it always gives the same result for this type of measurements on the same image. For this indication, I think the machine is better suited,' Zanca concluded.

AI puts safeguards that may help prevent human errors, d'Assignies added. 'For example, with a pulmonary nodule detection tool, the nodule threshold can't be set at 20mm, otherwise nothing will be detected,' he explained. Radiation dose could be another instance where the machine should disobey an ill-advised order. 'AI could warn when a radiologist would use too high a dose,' Zanca said. 'Today, we have a simple limit protection that is already embedded in the system. But AI could be used to drive exposure parameters.' Recent reader performance studies focus on augmented AI, i.e., comparing human performance with the machine vs. human performance alone. However, radiologists should beware the risk of deskilling that comes with augmented AI; when professionals get used to a system doing something for them, that run the risk of losing the ability to perform this task themselves. Zanca 'If the system fails, radiologists still need to be able to interpret images without AI.' ■

Report: Mélisande Rouger

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Imaging investigation and diagnosis

Multiparametric ultrasound: the future of the modality

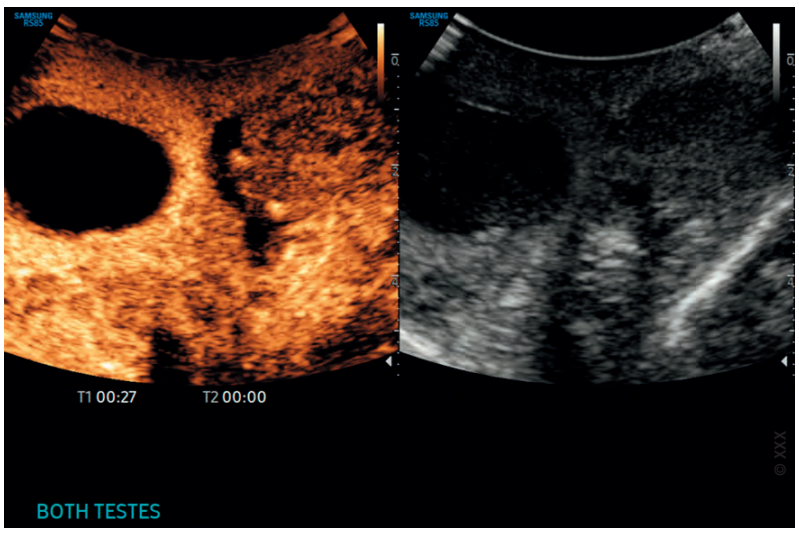


Image of a contrast enhanced testicular ultrasound demonstrating right testicular infarction.

Multiparametric ultrasound will play an increasing role in imaging investigation and diagnosis as more subspecialities reap the benefits from the modality, Professor Paul Sidhu believes. The leading expert predicts that it will be more cost-effective and comfortable for patients and take point-of-care-testing onto a new level by embracing other parameters in the imaging process.

Sidhu discussed the benefits, advantages and advances of multiparametric ultrasound over other modalities as part of his presentation 'The future of ultrasound' at the British Institute of Radiology congress in London in late September. The expert, who is Professor of Imaging Sciences at King's College London and consultant radiologist at King's College Hospital, outlined the history of ultrasound and its evolving clinical use, and suggested that radiologists are 'losing interest' in preference to other imaging modalities.

He pointed to sonographers and other subspecialty clinicians – such as obstetricians, gynaecologists, cardiologists, and physiotherapists – increasingly using ultrasound, and particularly multiparametric ultrasound. Point-of-care ultrasound, Sidhu notes, is used in A&E departments, and in medical schools as part of the curriculum for students to learn anatomy. He discussed how radiologists prefer MRI and CT, and in the UK perform only about 8-10% of ultrasound scanning, with the rest conducted by sonographers.

'Using ultrasound to its full potential'

Ultrasound is practised elsewhere in the hospital, away from radiology departments, Sidhu notes, seeing this development as a continuing trend. 'In Europe, and in Germany in particular,' he said, 'ultrasound is used by many subspecialists: renal physicians, urologists, hepatologists, gastroenterologists, and general practitioners. It is not radiology-based, more is done by non-radiologists.'

So, how will the modality fare in a 'radiology' context? The expert believes multiparametric ultrasound is the major evolution, measuring more than one parameter. 'Other subspecialties outside radiology embrace multiparametric ultrasound much more than radiologists do,' he said, 'and are using ultrasound to its full potential.'

An undersold modality

Sidhu, who first coined the phrase multiparametric ultrasound a decade ago, believes that ultrasound is undersold, particularly in comparison to MRI, where investigations are also being termed as multiparametric. 'Ultrasound is the pioneer in multiparametric imaging because you have B-mode, but there is also colour Doppler, spectral Doppler and power Doppler. Microvascular imaging gives imaging down to capillary level using very sensitive Doppler, while contrast-enhanced ultrasound has the ability to look at time intensity curves, wash-in and wash-out curves, and look at areas under the curve, assessing haemodynamics of the structure under investigation.

'This can monitor tumour response much more accurately than CT or MRI, is much cheaper, and it is better for the patient as well as they do not have to undergo a potentially invasive or uncomfortable investigation.'

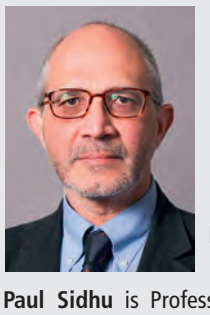
In addition, he points to ultrasound with elastography to measure stiffness in the liver, and how the different techniques of elastography, including point and 2D shear wave, are useful in liver assessment and liver fibrosis. 'Strain elastography gives a colour map of the areas of hardness,' Sidhu said. 'There are also techniques which quantify fat levels in the liver to the same level of accuracy as MRI but at a fraction of the cost and this will revolutionise imaging of the liver in the future. Multiparametric imaging of the liver will become a one-stop clinic with every possible parameter imaged, recorded, and quantified using ultrasound; this is multiparametric at its premium. Multiparametric is the strength of ultrasound imaging, and that is also the future for ultrasound. It brings all the techniques under one umbrella.'

Point-of-care imaging brings physicians closer to the patients

Patients benefit because the modality can be applied 'quicky, smoothly, painlessly and accurately' and physicians can be next to the patient to offer reassurance, Sidhu explained. He pointed to the example of finding a focal live lesion in a patient referred from primary practice, where findings are benign in 9 out of 10 cases. 'Using contrast-enhanced ultrasound, you can make the diagnosis without uncertainty within 2-3 minutes and tell the patient that they have a benign lesion and they are fine, instead of waiting three months for a clinical appointment.'

Another advantage is the miniaturisation and quality of the ultrasound machines, and the ability to use a smartphone or tablet to perform an ultrasound examination. This transfers ultrasound to the point-of-care physician to diagnose at the bedside at minimal cost, maintain close contact with the patient, as opposed to CT or MRI, with that closer interaction with the patient at the time of examination making the diagnosis more secure. ■

Report: Mark Nicholls



Paul Sidhu

Paul Sidhu is Professor of Imaging Sciences at King's College London and consultant radiologist at King's College Hospital. His research interests include contrast-enhanced ultrasound, non-invasive liver imaging and dose reduction in children. He is an ex-President of the British Medical Ultrasound Society and European Federation of Societies in Medicine and Biology. He is Editor-in-Chief of Ultrasound in Medicine and Biology.

First-incident ischemic stroke patients

White matter hyperintensities in the brain: valuable biomarker to assess mortality risk

White matter hyperintensities (WMH) on the brain seen on MRI represent a biomarker associated with a 50/50 risk of death within five years after a first incident acute ischemic stroke (AIS) or transient ischemic attack (TIA).

Neurologists at the University of Bern have reported that prevalence and quantity of WMH are independently associated with mortality, and that patients with moderate or severe WMH and additional chronic covert brain infarctions (CBI) had the highest risk of death in a study published in the Journal of Neuroimaging.

The findings are based on an analysis of mortality outcomes over 8,179 patient years of 2,236 consecutive patients who received treatment for first incident AIS or TIA at the comprehensive stroke centre of Bern University Hospital. The study investigated both the association of different phenotypes (observable physical properties), the quantity, and the locations of WMH and CBI with death, and also to determine if the presence of both improved predictability. WMH – subcortical lesions that appear as increased bright areas in the brain – are known from prior research to be associated with increased risk of stroke, Alzheimer's disease and other dementias, and death. Little is known about the phenotypes of CBI.

The researchers counted and mapped the location of CBIs, which included large subcortical infarcts, isolated grey matter lesions, combined grey and white matter lesions, and lacunes. They similarly counted and mapped the locations of WMH, as well as using the Age-Related White Matter Changes (ARWMC) scale to assess the severity of WMH. Using this classification scheme, they were able to differentiate between lesions that correspond to ischemic injury due to small-vessel disease and ischemic injury likely to be caused by embolism to the brain.

All patients had undergone an MRI scan upon admittance to the hospital or within one week of diagnosis. Their median age was 71 years (range 59–80), and 57% were male. The patients were followed for a median of 4 years. The study did not track specific cause of death.

Mortality rates

Principal investigator Thomas Raphael Meinel, MD, of Bern University Hospital's Department of Neurology, and colleagues reported that patients without WMH had the least risk of dying, representing only 9% of deaths. The mortality was highest for patients with moderate or severe WMH (ARWMC 2 or 3) and CBI, at 37%, compared to 13% for patients with minimal WMH (ARWMC 0 or 1) and no evidence of CBI. Mortality was not associated with CBI phenotype, location, or count.

The higher the ARWMC score representing increased WMH, the greater the risk seemed to be of dying. Forty-nine percent of patients with ARWMC 3 ratings died, compared to 29% with ARWMC 2, and 20% with ARWMC 1. Twenty-nine percent of patients with any CBI died, compared to 17% without any.

'These brain frailty markers can be easily assessed without the need for advanced postprocessing,' write the authors. 'WMH can be reliably assessed on both routine 1.5 or 3 Tesla MRI and CT, and CBI on MRI. WMH are a more suitable surrogate marker than CBI for long-term mortality after stroke or TIA. Our study shows that 50% of patients with severe WMH have a life expectancy of five years after the event.'

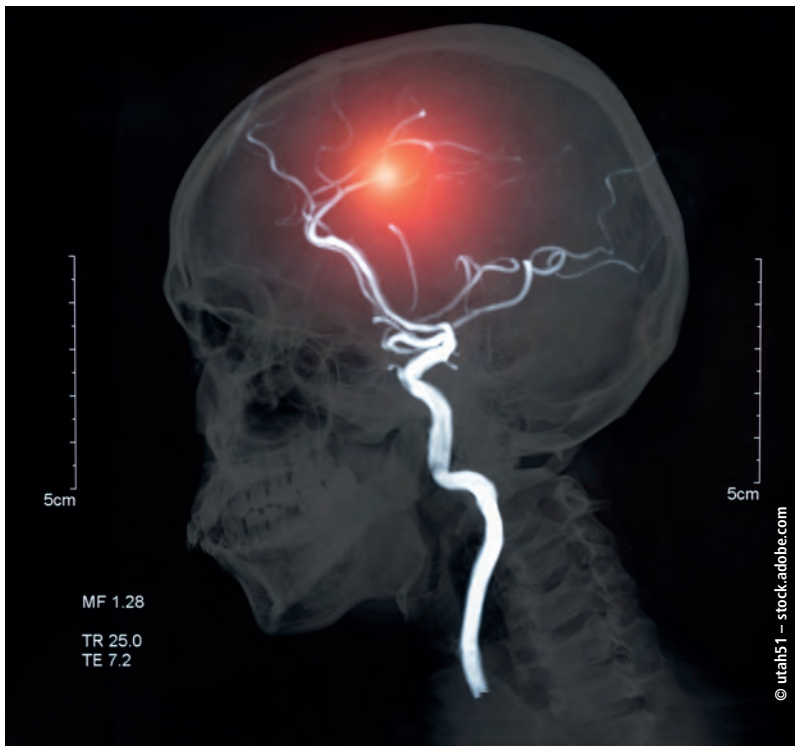
As deadly as cancer - but more preventable

'It is appropriate to communicate with high-risk cardiovascular patients in a manner similar to communicating with oncology patients,' Meinel tells European Hospital. 'But unlike a cancer diagnosis, cardiovascular disease is highly preventable, and treatable by exercise, healthy diet, smoking cessation, blood pressure control, and medication.

Significant risk for stroke recurrence

'We tell patients with a high ARWMC score that there is a significant risk for stroke recurrence, and other major cardiovascular events including death. It is also important to note that not all WMH are due to vascular risk factors, but possibly due to a genetic mutation, and that these people may be living a very heart-healthy lifestyle,' he adds. 'At Inselspital Universitätsspital Bern, we provide a detailed tailored package of interventions for each patient. We follow-up with the high-risk patients to ensure that the risk factors are well controlled and that the patient adheres to the optimal medication.' ■

Report: Cynthia E Keen



Thomas Raphael Meinel

Thomas Raphael Meinel, MD, is a an attending physician and group leader in the Stroke Center Bern of the Department of Neurology at Inselspital Universitätsspital Bern, Switzerland. His key research fields are stroke imaging, with an emphasis of covert brain infarction, futile interventions in endovascular stroke treatment, anticoagulation and stroke, and stroke prevention.

UPCOMING EVENTS IN RADIOLOGY

3.-5.11.2022
Central German Neuroradiology Symposium, Dresden, Germany

19.11.2022
26. International Mammadiagnostics, online

27.11.2022
RSNA, Chicago, USA

12.-14.1.2023
IROS, Salzburg, Austria

1.-5.3.2023
ECR, Vienna, Austria

14.-17.3.2023
European Molecular Imaging Meeting, Salzburg, Austria

Cancer screening

The need for breast imaging for transgender individuals

The need for breast cancer screening of transgender individuals has been a topic of uncertainty until recently, due to lack of reliable patient data, consensus by radiologists, published research, and recommended guidelines. A 2021 survey of Society of Breast Imaging (SBI) members revealed that 'breast radiologists differ in their practice and knowledge regarding screening of transgender patients,' according to the study's principal investigator Emily B. Sonnenblick, MD, of the Icahn School of Medicine at Mount Sinai in New York City. SBI responded by sponsoring a summer webinar to discuss what radiologists need to know.

The Williams Institute, a Los Angeles-based research organization focused on sexual orientation and gender identity law and public policy, estimated that in 2022, over 1.6 million adults and teenagers in the the United States identify as transgender, double the number it estimated in 2011. This population has a steadily increasing percentage of younger aged individuals, many believed to be undergoing gender-affirming therapy. In 2017, the Endocrine Society published guidelines endorsing the prescribing of gender-affirming hormone treatment of adolescents with gender dysphoria/gender incongruence starting at 16 years, the age of informed consent in the US.

Estrogen has increasing risk of breast cancer

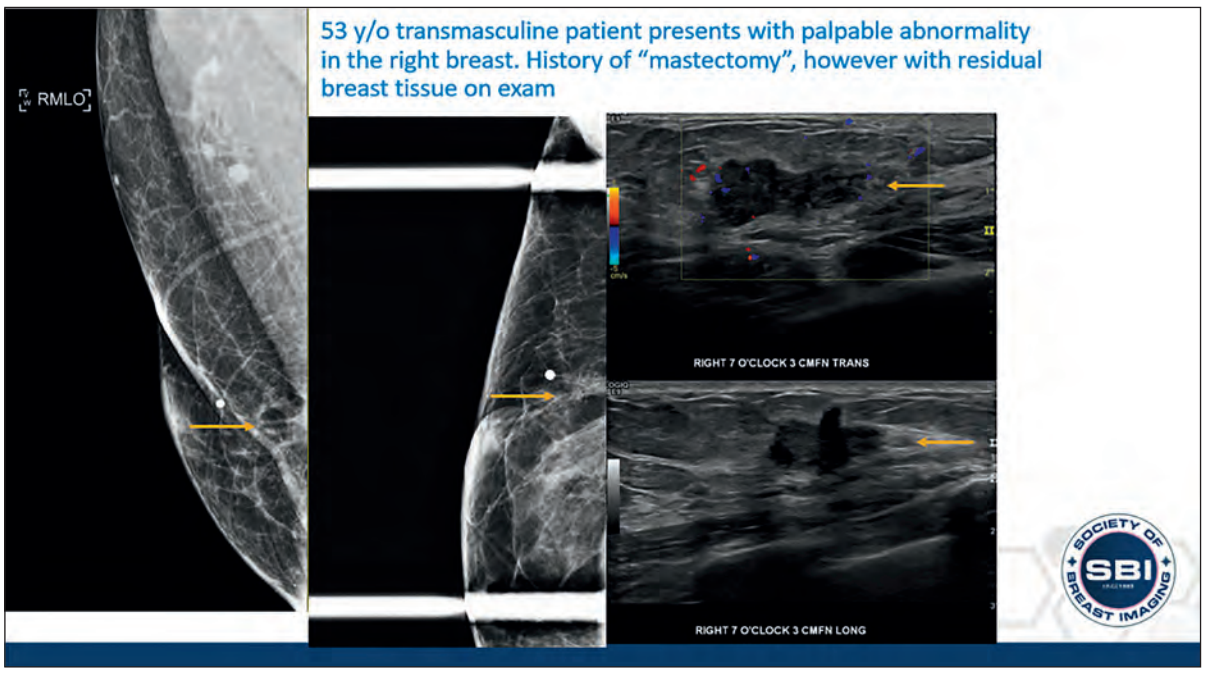
Estrogen, which stimulates mammary development, is associated with an increased risk of breast cancer. The incidence of breast cancer in transgender individuals is unknown, due to lack of longitudinal studies and substantive data about patients. But a 2019 study from VU University Medical Centre in Amsterdam, the Netherlands, investigating the incidence and characteristics of breast cancer in 2,260 transgender women and 1,229 transgender men in the country compared with the general Dutch population revealed that transgender women had a 46-fold higher incidence of invasive breast cancer than cisgender men. Cases are rare, but they are increasingly being reported in professional medical journals.

'Histologically, hormonal-induced breast tissue is similar to that of cisgender women,' explained webinar presenter Mai A. Elezaby, MD, Associate Professor of Radiology at the University of Wisconsin School of Medicine and Public Health and Associate Chief of Breast Imaging at University Hospital in Madison. 'The developing breast tissue in transfeminine patients receiving hormonal therapy is similar to cisgender women, and hence has the potential to develop the full spectrum of benign and malignant pathologies.' Transgender masculine patients who have breast reduction and contouring surgery rather than complete bilateral mastectomies also may be at risk because they still have some intact breast tissue. While the Dutch study showed that the 1,229 participating transgender masculine individuals had a lower rate of breast cancer than cisgender women, they still need mammography screening, especially if genetic testing identifies a BRCA mutation or they fit a moderate-to-high-risk profile. The ACR reports a lifetime risk of under 15%, 15%-20%, and over 20% for transgender men meeting average-, moderate-, and high-risk profiles respectively.

Important: What type of breast surgery?

Elezaby said that it was very important for radiologists to learn what type of breast surgery transmasculine patients had undergone. Mastectomies performed for treatment of breast cancer or for risk reduction remove all breast tissue, the inframammary fold to the clavicle, and medial to lateral from the latissimus dorsi/axillary tail to the sternum. The nipple-areola complex is also likely to be removed. Although cosmetic breast reduction and contouring 'top' surgery removes much of the central breast tissue, often the upper pull of the breast tissue is preserved as well as the nipple-areola complex.

'Patients having 'top' procedures would benefit from pathologic evaluation because the breast tissue



may contain significant pathology. Atypia, carcinoma in situ, or invasive carcinoma can be identified in between 1.5%–4.7% of transmasculine individuals undergoing gender-affirming chest masculinization,' she said, citing a 2020 study from pathologists at NYU Langone Health in New York City.

The ACR's breast cancer screening guidelines, based on a person's sex assigned at birth, risk factors, and use/duration of hormone therapy, are:

- Transfeminine individuals who have been taking hormones 5+ years should have an annual mammogram or digital breast tomosynthesis (DBT) starting at age 40 if of average risk, and between 25 and 30 years if of higher risk. Screening starting at age 25–30 should be considered for all high-risk transfeminine patients, even those not taking hormones for less than 5 years.
- Transmasculine individuals who have had reduction mammoplasty or no chest surgery should have annual mammography or DBT starting age 40 if of average risk, age 30 and older if of moderate-risk, and age 25 and older if of high-risk. A supplemental breast MRI exam may also be appropriate for high-risk individuals. 'Radiologists need to engage healthcare providers about the importance of breast cancer screening for their transgender patients, as well as to inform patients without health insurance or who have been denied coverage of breast cancer screening exams that local, state, and national programs exist to provide financial assistance,' urged Elezaby. 'It's important to take steps to create a welcoming, non-discriminatory and secure environment in radiology departments for all the diverse populations we serve.' ■

Report: Cynthia E. Keen

Alternative to lumpectomy

Breast cryoablation for surgically inoperative patients

Breast cryoablation is an emerging treatment for early-stage, localized breast cancer that destroys malignant tumours by freezing them. During the past decade, it has been increasingly utilized as an alternative to lumpectomy, but its long-term benefits compared to other breast cancer treatments are still unproven.

Breast cryoablation is a non-invasive, less than 60-minute-long outpatient procedure performed with a patient awake under local anaesthesia. The treatment causes fewer complications than breast-conservation surgery, has minimal impact on surrounding breast tissue, has less post-op pain management, and much better cosmesis. It is much less expensive, because it eliminates the need for operating room staff and equipment and requires less post-operative clinical follow-up. In addition to treating early-stage breast cancer treatments, it is used to destroy benign breast lesions and fibroadenomas, to treat patients with Stage IV metastatic breast cancer, and to treat patients unsuitable for surgery.

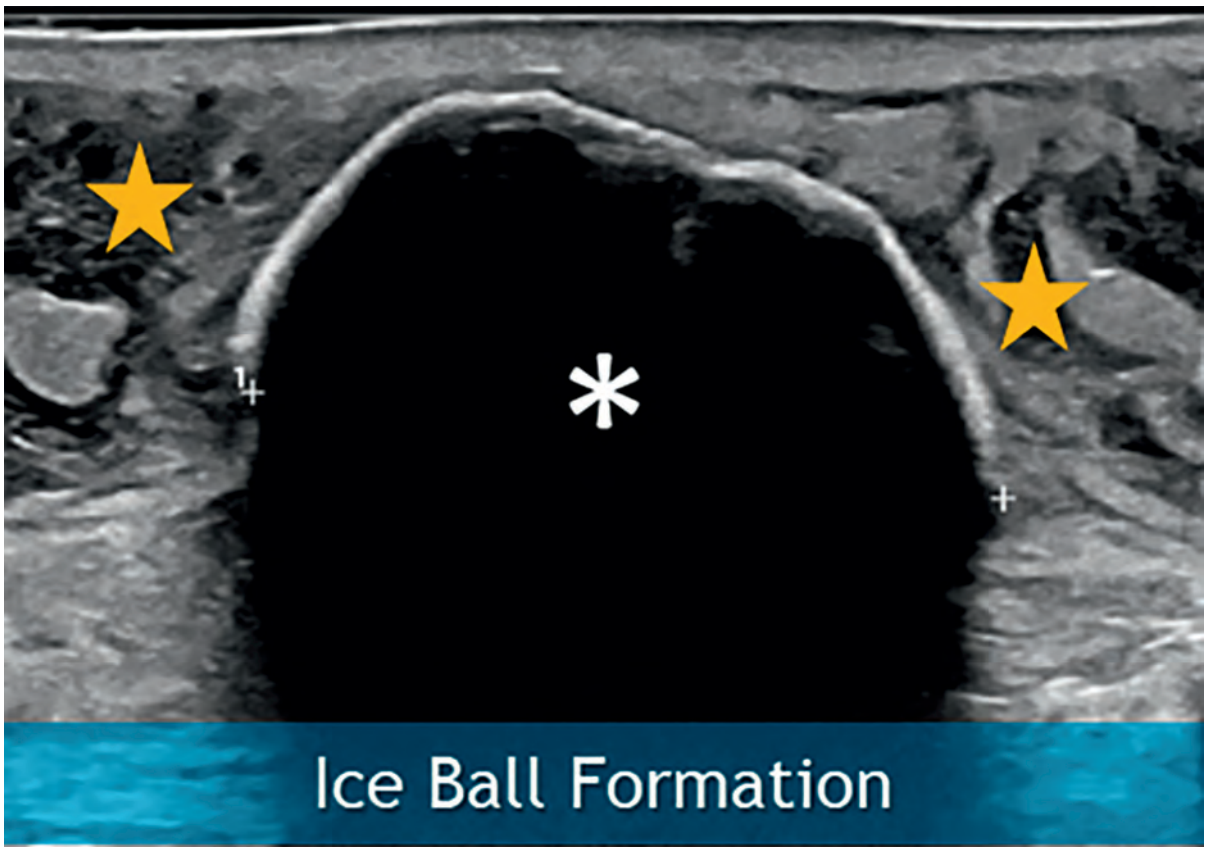
Tips to make treatment easier

Sarah E.H. Moorman, MD, a breast imaging fellow at the University of Michigan School of Medicine in Ann Arbor, presented the hospital's experiences with breast cancer patients for whom surgery would present a high risk. In addition to discussing patient demographics and outcomes, she explained the procedure and offered tips to make the treatment easier for both radiologists and patients. Moorman reported that the findings of the study also showed that this was a safe and effective procedure for women who do not meet the criteria of the largest multi-institutional breast cryoablation clinical trial (ICE3) currently being conducted.

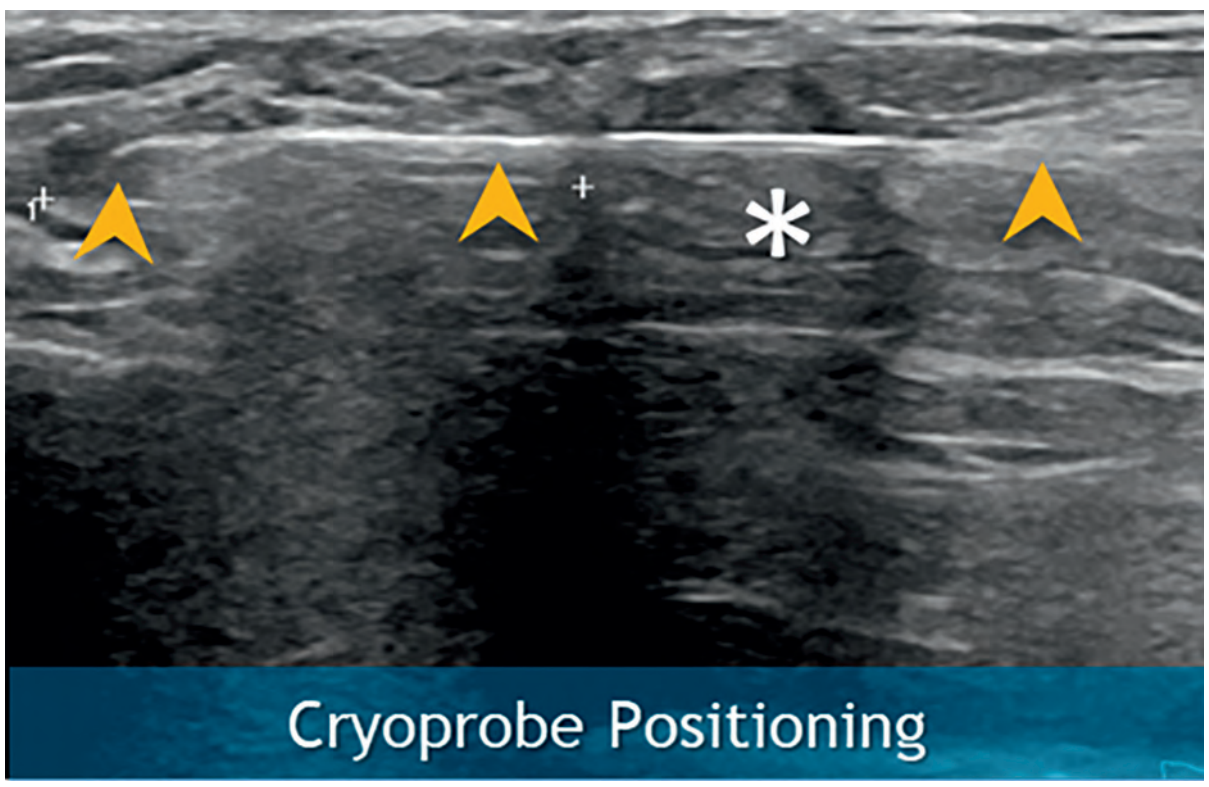
The 16 patients in the study ranged in age from 57 to 94. All had comorbidities that made them poor surgical candidates, including prior stroke and serious cardiovascular conditions, advanced liver disease, COPD, emphysema, interstitial lung disease, and/or high risk of deep vein thrombosis and pulmonary embolism. To identify candidates for breast cryoablation, a surgical oncologist used surgical risk calculators while conducting preoperative evaluations, and then discussed the cases with a radiologist.

Discussing the odds

In addition to surgical risks, the physicians discussed the odds of patients surviving longer with proactive management of their breast cancer, and those for whom anti-endocrine therapy may not be effective. None of the patients met the all-inclusion criteria used by the ICE3 trial, an ongoing clinical trial evaluating the safety and efficacy of liquid nitrogen-based cryoablation in 194 patients aged 60+ years. The ICE3 participants had unifocal, ultrasound visible low-to-intermediate stage invasive ductal carcinoma 1.5 cm or less in size, HR+/HER2-, and with no extensive ductal carcinoma in situ, invasive lobular carcinoma, or metastatic disease. The Michigan patients had one or more tumour characteristics outside of the ICE3 criteria, including tumour size greater than 1.5 cm, invasive lobular carcinoma and/or DCIS, tumours less than 0.5 cm from the skin, and ER/PR negative tumours.



Iceball from cryoablation freeze cycle (*) encompasses the malignant mass. Saline (stars) between skin & ice ball protects the overlying skin from injury from freezing temperature of cryoablation/underlying iceball



Cryoprobe (arrowheads) positioned through the center of the malignant mass (*)

Cryoablation is based on the cytotoxic effects of cold that destroy cellular tissue, and consists of a first freeze, a passive thaw phase, and a second freeze. Cold temperatures freeze extracellular water, drawing water out of the cells and causing cellular dehydration. The cells swell and rupture during the passive thaw phase. The second freeze takes advantage of tissues that have been injured during the first freeze and conduct cold temperatures more efficiently, enhancing the damaging effects of cold and expanding the area of tumour necrosis.

The procedure consists of using ultrasound imaging to guide a thin, needle-like device through the skin and into the breast tumour. The area is blasted with liquid nitrogen for 6 to 8 minutes at -40 °C or lower, followed by a 10-minute thaw, and a second 6- to 8-minute freeze. 'We identified several challenges with our patients,' said Moorman. 'Superficial tumours risk skin necrosis during cryoablation. Because saline can dissipate rapidly in pendulous fatty breast tissue, we used a 21G needle for rapid saline infusion, had a dedicated operator managing saline needle positioning, and stocked the procedure room with extra bags of saline.' She added: 'Positioning of elderly patients can be difficult, especially for patients with large breasts, neck mobility issues, and the inability to extend an arm above their head. We recommend allowing extra time for the procedure, using a wedge for patient positioning and comfort, keeping the breast in position with paper tape, and placing the patient's arm at their side or across the abdomen. Patients with comorbidities such as COPD or congestive heart failure may have shortness of breath and decreased oxygen, and risk hypoxia and fluid overload. We provide oxygen to these patients and elevate the head of the bed by as much as 45°. Targeting of the mass is likely feasible with needle entry from lateral, medial, or peripheral breast, but requires about 5-6 cm of tissue depth from surface,' she explained.

Moorman advised that fat necrosis is expected to be seen on follow-up imaging, and that any changes near the cryoablation cavity suspicion findings should be promptly biopsied. All of the patients recovered rapidly, and none experienced serious side effects. ■

Report: Cynthia E. Keen

Data protection

A shared EU data space for health?

At least since the General Data Protection Regulation (GDPR) came into force in 2018, if not even before that, the EU has been comparatively strict with regard to the protection of personal data within its member states. While the GDPR is generally considered a success, setting standards even outside its jurisdiction, critical voices are becoming louder.

In the wake of the Covid pandemic, questions have been raised whether the management of this health crisis could have been more effective if the data sharing within and between states had been easier. Or, as the more polemic among media voices are asking, is too much data protection costing lives? There must be a way to safeguard health and other sensitive personal data and at the same time to improve the management of health crises, to enable scientists to further our understanding of health conditions, to accelerate digital health innovations and to facilitate patient care across borders – or at least these are the hopes of the European Commission (EC). The solution is going to be a shared European data space specifically designed for the health domain.

Accordingly, in May 2022, the EC submitted a "Proposal for a Regulation of the European Parliament and of the Council on the European Health Data Space'. If this proposal is successful, the resulting regulation will require all member states to provide their citizens with easy and free electronic access to their healthcare data. These interfaces will be compatible between states and with the central healthcare data exchange platform named „MyHealth@EU'. The EC will take responsibility for MyHealth@EU and its roll-out to all member states, to be finalized by 2025. Until then, each member state will have to appoint a national authority for the implementation and oversight of MyHealth@EU access. In a manner of speaking, MyHealth@EU is the physical correlate of the regulatory concept of the European Health Data Space (EHDS).

Lawful and unlawful uses of health data

Access to health data will be granted not only to patients and their healthcare professionals. Explicitly, MyHealth@EU will also permit data sharing with scientists, developers, politicians and government officials. However, for all purposes except patient care, access is supposed to be limited to anonymized or pseudonymized data. By facilitating not only patient care but also pharma and digital health innovations and making existing data sharing processes more efficient, the EC expects economic gains of about € 11 bn while planning for additional infrastructure costs of € 810M.

In addition to anonymization and pseudonymization, some potential uses of health data will be explicitly forbidden under the new regulation, according to the EC's proposal. MyHealth@EU data may not be used for health-related advertising and marketing purposes; it may not be analyzed in a way that could lead to higher insurance premiums or the exclusion of certain insurance benefits; and it may not be used for research with the intent of developing new harmful substances and products, for instance those related to nicotine or alcohol consumption.

developed by and hosted in countries that are less privacy-sensitive and may have no compunctions at all in exploiting anonymized and non-anonymized healthcare data for economic purposes. It must be assumed that large datasets of EU citizens' healthcare data are already owned by non-EU tech companies because their platforms are used for informal data sharing in various contexts.

Next steps: EU Council and EU Parliament

In the next steps, the EC's proposal will be debated and commented upon by the EU Council and the EU Parliament. Considering the aforementioned issues surrounding privacy and security, but also the potential for economic gains and growth, discussions in the member states will certainly be controversial. The EU Council may come to a decision as early as the second half of 2023. But if one or several member states have more severe objections, the EHDS may be delayed for years. For instance, German data protection activists are already taking proceedings against similar legislation: pseudonymized data of 73 million citizens was going to be collected and used for research purposes. An urgent court appeal was made to stop this process while court proceedings are still pending.

The EC's proposal can be viewed at https://health.ec.europa.eu/system/files/2022-05/com_2022-197_en.pdf. ■

Report: Dr Christina Czeschik

MyHealth@EU

As part of MyHealth@EU, two electronic cross-border health services are already being rolled out gradually in all EU countries:

1. ePrescription and eDispensation
It allows EU citizens to obtain their medication in a pharmacy located in another EU country, thanks to the online transfer of their electronic prescription from their country of residence where they are affiliated, to their country of travel.

2. Patient Summaries
They provide information on important health related aspects such as allergies, current medication, previous illness, surgeries, etc. It is part of a larger collection of health data called electronic Health Record (EHR). The digital Patient Summary is meant to provide doctors with essential information in their own language concerning the patient, when the patient comes from another EU country and there may be a linguistic barrier.

In the long term, medical images, lab results and hospital discharge reports will also be available across the EU, with the full health record to follow later on. The exchange of ePrescriptions and Patient Summaries is open to all the EU countries.

By 2025, both services will be gradually implemented in 25 EU countries: Austria, Belgium, Croatia, Cyprus, Czech Republic, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Slovenia, Spain, Sweden, Slovakia, Latvia, and Bulgaria. The eHealth Digital Service Infrastructure (eHDSI) facilitates the cross-border exchange of health data including patient summaries and ePrescription. Through 'core services', the European Commission is providing a common information and communications technology infrastructure and crosscutting services (terminology, interoperability etc.) to EU countries. They can then set up 'generic services' to connect national eHealth systems through 'National Contact Points for eHealth (NCPeH)'.

Lawful and unlawful uses of health data

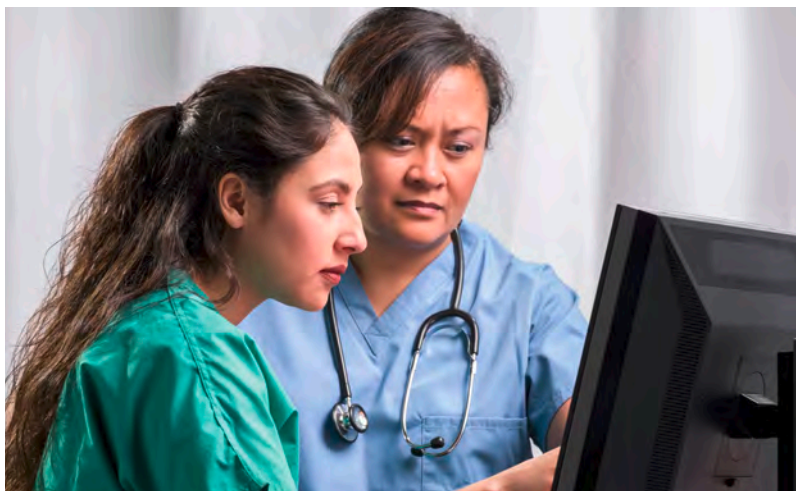
However, this „black list' shows that the EC is already very much aware of the abuse potential of such a shared data space, and that companies with unsavoury business models may already be waiting in the wings. Also, as the EC itself points out in the proposal, it cannot guarantee perfect security against de-anonymization of previously anonymized patient data. Anonymization is a difficult problem in data science, and there are numerous approaches that sometimes permit the re-identification of individual persons or small groups. Pseudonymized data are even more vulnerable to re-identification.

But all these problems notwithstanding, the EU badly needs some form of shared and interoperable data space for its citizens' health data. More efficient data sharing will improve political decision making in future crises, improve actual patient care and speed up innovations in pharma and health technologies. If the EU does not create a safe legal way of sharing data, its citizens and companies will sooner or later use non-EU infrastructure,

Sponsored · A tool to empower healthcare organizations

Eliminating silos and improving patient outcomes

Clinician and nurse burnout is a frequently discussed topic in the healthcare community in the wake of the Covid-19 pandemic. According to an analysis of the NHS published earlier this year, more than 400 workers in England have left the NHS to restore work-life balance within this past year. Burnout and cases of post-traumatic stress disorder after working through the Covid-19 pandemic are major causes of the departures. Less widely discussed is the impact staff burnout and other consequences of the Covid-19 pandemic are having on the quality of care that hospitals deliver.



Healthcare institutions are constantly aiming to ensure high-quality patient outcomes, attain maximum efficiency, and reduce healthcare-related costs. This is always a challenge; in this age of staffing disruptions, it is even more so. Finding systematic solutions to improve healthcare quality, therefore, is a key focus for healthcare systems today.

Hospitals and health systems are finding that they can no longer approach quality improvement (QI) in a dispersed manner. Survey results from the Quality Improvement Conference in Gothenburg, Sweden, held in June of 2022 showed that the largest concerns that organizations presently have are a lack of standardization and workflow silos. The unnecessary duplication of efforts and unsupported decision-making stemming from these issues can have a significantly negative impact on patient care and outcomes, as well as on the financial health of the organization. Healthcare institutions are finding that they need to implement innovative technologies that break through deep-seated silos, establish successful strategies, and enable rapid decision making.

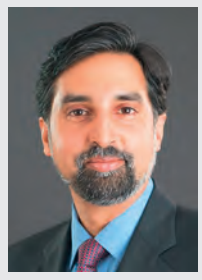
To facilitate change management and a progression of continuous quality improvement, a workflow tool that helps makes processes more efficient, successful, and collaborative is needed. One example is Ovid Synthesis Clinical Evidence Manager, developed at Wolters Kluwer, a tool that empowers healthcare organizations to foster an innovative culture by reducing duplicative efforts, promoting collaboration, and streamlining research. The cloud-based workflow management solution offers a centralized dashboard view of all quality improvement research projects within an organization, improving consistency in workflow management.

Users of Ovid Synthesis are finding the solution to be a powerful resource in terms of collaboration, standardization, and promoting alignment across different departments within their organizations as well as in other geographical areas. They also find it to be a transformative tool by allowing new clinicians to adapt to evidence-based practices within their hospitals.

Still, without executive leadership emphasizing the core tenets of a culture of quality improvement, no tool can deliver meaningful results by itself. Communication, observation, and education are the main drivers of change management, and silos will remain if those values are not reflected by hospital leadership. Health system CEOs and executive teams will be the champions of change and must encourage a culture of transformation to drive new enhancements.

With support from the top, sustainable change can be achieved by starting with an evidence-based approach and integrating tactics to engage hospital staff, increase employee morale and confidence in the organization, and secure buy-in from prominent stakeholders. Hospitals can make a significant impact on quality improvement and performance by combining an evidence-based methodology with proven purpose-built technologies. ■

Report: Vikram Savkar



Vikram Savkar

Vikram Savkar is the Senior Vice President and General Manager, Medicine Segment of the Health Learning, Research & Practice business at Wolters Kluwer. Previously, Mr. Savkar served as General Manager for several businesses in the Legal & Regulatory division before joining the Health Division in late 2019. Prior to joining the company, he held senior positions at Nature Publishing Group and Pearson Education and has earned degrees in Physics and Classics from Harvard University.

Sponsored · Clinio series

All-in-one computer for use in hygienically sensitive areas

Nowadays, the operating theatre is networked and staff have access to a wide range of information and image data. With the Clinio, Rein Medical offers a medical all-in-one (AIO) computer that has been designed for use in hygienically sensitive areas and can be used both as a thin client and as a full PC system.

'With the Clinio, users can retrieve and process data from medical information and imaging systems such as HIS, RIS, PACS, PDMS or operating theatre image management. We only use highly available components that are well-known in the industry. These are particularly powerful, temperature resistant and consume little power,' says Gernot Schnock, Development & Product Management at Rein Medical. This makes the Clinio extremely robust, extremely low-maintenance and designed for continuous 24/7 use. With its VESA 100 mounting device, the AIO computer can be individually wall mounted, attached to ceiling lamps or installed on mobile and stationary workstations.

Hygiene is a top priority

As the Clinio is designed for hygienically sensitive areas, it can be used not only in the operating theatre but also in the central sterile supply department, the emergency room, intensive care and IMC wards, the shock room, during mobile ward rounds on a trolley or as a documentation workstation.

The enclosure is made entirely of aluminium; it is hermetically sealed and fanless to prevent active air exchange with the environment as well as swirling of dust and germs in the surroundings. 'The IP65-protected front and the surface coated with the germicidal powder coating Polyflex Steridur II allow for easy wipe disinfection. The Clinio is resistant to listed surface disinfectants of the VAH disinfectant list,' Schnock explains.

The optimised housing shape has smooth surfaces and no cooling fins, ensuring safe and hygienic preparation. The glass pane is fitted flush and sealed as well as circumferentially protected against mechanical damage. The protective glass made of micro-etched glass features a high anti-reflective effect and non-sparkling effect (anti-glare). The hygienic flap of the connection panel with IP54-certified cable feed-through can be opened without tools.

The Clinio is operated via the command bar, a hygienic and wear-free control panel behind glass that can also be operated with surgical gloves. 'This is used, for example, to switch the computer to stand-by mode and to activate or deactivate the touch or keylock. The device automatically goes into keylock status after start-up, so the touch on/off function remains usable for cleaning purposes. If keylock is switched off manually, the device remains in this status and enables permanent operation via the keys,' explains Schnock. If they want to, users can also enter data using a stylus.

Even more optional possibilities

To make data collection easier, a barcode reader with omni-directional scanning function can be integrated on the underside of the Clinio, as well as a multi-frequency RFID reader behind the protective glass. The optionally mountable soundbar with DSP sound processor delivers a clear reproduction of audio files and is optimised for speech reproduction. The devices of the Clinio AIO series are scalable in terms of screen size from 21.5" to 27", performance class, storage capacity and much more. ■

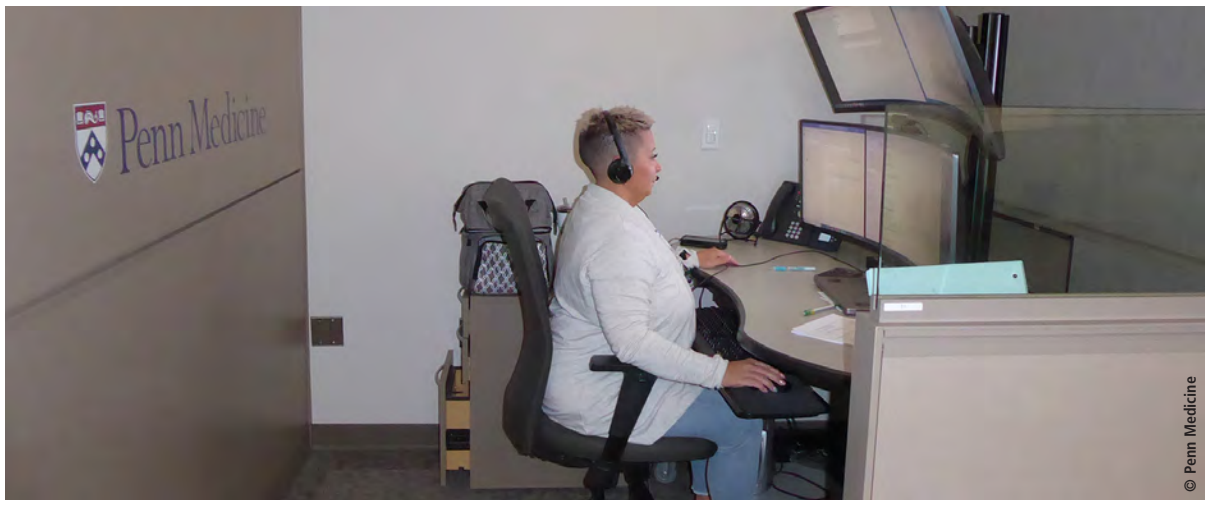
- Class 1 medical device according to MDR (EU) 2017/745 with strict conformity assessment procedure.
- Certified according to EN 60601-1-2:2015
- Certified according to EN 60601-1:2013-12
- Emission/interference resistance according to EN 55032:2015 Class B / CISPR32:2015
- Risk management report according to EN ISO 14971
- Usability test EN 60601-1-6
- EUDAMED registration

With this, Rein Medical offers operators and system integrators easy integration and a special level of safety when creating medical systems in the near-patient environment.

ICU response to the Covid-19 surge

Tele-delivery of respiratory therapy services: a resounding success

In their pursuit of solutions for pandemic challenges, a US hospital system applied telemedicine principles to respiratory therapy – with impressive results.



A remote respiratory therapist at work at Penn Medicine.

When the coronavirus SARS-CoV-2 struck with a vengeance in March 2020, Penn Medicine, a multi-hospital system in greater metropolitan Philadelphia, faced an acute shortage of respiratory therapists (RTs) to treat an escalating number of critically ill patients in respiratory distress. A high demand for RT staff already existed at Penn, which would be exacerbated by the need to remove RTs with underlying medical conditions from the risk of contracting the virus from inpatient bedside work shifts.

Hospital management anticipated possible losses among the staff secondary to Covid-19 as well. Finally, various options were considered for limiting exposure and cross-contamination between staff and patients during pandemic-focused and routine care.

To avert this escalating crisis, the hospital system launched a telemedicine respiratory therapist (eRT) service in April 2020, integrating it into the University of Pennsylvania Health System (UPHS) tele-ICU program. First established in November 2004, the Penn E-lert service is a state-of-the-art electronic intensive care unit (ICU) that continuously monitors and evaluates critically ill patients in all UPHS hospital ICUs, proactively identifies impending or evolving patient problems, and assists in or directs on-site clinical management. It is staffed 24/7 by experienced critical care nurses and intensivist physicians from the Departments of Anesthesiology and Critical Care, Emergency Medicine, Internal Medicine and Surgery.

Close to the patient, watching from afar

Initially, the eRT service was staffed at start-up by seven registered RTs with 11 to 24 years of practice, all of whom had health conditions that would not allow them to perform inpatient bedside services due to their high risk of contracting Covid-19. After a limited hours trial during the first 30 days of operation, coverage of the adult ICUs across five hospitals expanded to 24/7 as of May 2020. The service was set up parallel to the existing tele-ICU services and provided coverage for 16 different Covid-19 specific and non-Covid ICUs, with a nominal bed capacity of 320. On-site ICU coverage was maintained at one RT for every 12 patients.

The remote RTs visually monitored both intubated and non-intubated patients experiencing respiratory compromise via ICU-installed cameras, microphones, and specialized systems to deliver tele-critical care services. They completed compliance-required medical documentation, conducted regular ventilator checks, assessed compliance with low tidal volume ventilation, and surveyed endotracheal tube occlusion and reintubations. They also often served as safety officers during high-risk pre-extubation procedures, subsequently remotely monitoring these patients.

Requests for specialized eRT services could be made by staff in the ICUs in addition to ongoing performed workflow by eRT. The system included an automated alert triggered by the patient's electronic medical record or an electronic 'sniffer' aimed at detecting acute respiratory distress syndrome (ARDS). Clinical staff could also request aid by pushing an emergency button in the ICU and talk to the remote RT immediately by phone.

Much of the immediate acceptance of the tele-RT service is attributed to the protocol that on-site RTs are always in charge of patients. The eRT is a consultative service, and all eRT clinical interventions are carried out only after discussion and approval of the bedside team. eRT staff can contact the primary on-site team to suggest changes in care delivery but cannot enter any orders without the knowledge of the primary clinical team.

Earlier intervention, better cost-efficiency, improved procedures

From May 2020 through August 2021, 31,609 RT activities had been performed, 97.8% of which were related to the routine established workflows. Over 1,500 interventions – most occurring at night and on weekends – resulted in avoiding several near-miss events, and improved patient care, according to Krzysztof Laudanski, MD, PhD, assistant professor of anaesthesiology and critical care at the Hospital of the University of Pennsylvania. He and his colleagues attribute this to the ability of an eRT to intervene early, often before the bedside RT.

Penn Medicine estimates that US $79,095 was saved in staff cost during the 16 months of the study. An estimated US $119,391 in additional savings was attributed to costs avoided by the remote RTs not needing to use personal protective equipment (PPE), and by enabling on-site RTs to use their time more efficiently in dealing with the increased patient workload caused by Covid-19. Additionally, the eRT service detected unfavourable practice patterns in ARDS treatment and intervened before the ARDS electronic 'trigger' was activated. In 2,685 cases the eRT service reduced harm to patients by aiding the implementation of a low stretch protocol in patients with ARDS, a protocol associated with a reduction in mortality and length of stay.

The eRT program is ongoing and greatly matured. A subsequent study is currently being conducted to investigate the optimal way to interact between eRT and bedside teams to assure the high reliability delivery of healthcare in ARDS, hyperoxia, extubation, and other targeted interventions using quantifiable improvement in patient care at a lower expenditure and burden to the staff. ■

Report: Cynthia E. Keen

Krzysztof Laudanski

Krzysztof Laudanski, MD, PhD, is an assistant professor of anaesthesiology and critical care at the Hospital of the University of Pennsylvania. He is a Physician Lead at Penn E-lert for Quality and Implementation. Laudanski works in the tele-ICU service and chairs the TeleICU Committee for the Society of Critical Care Medicine (SCCM). His research focuses on genetically driven and modifiable determinants of immunological recovery after burn, trauma, cancer surgery, Covid-19, and other critical care illnesses.

Assistance and decision-making systems

Artificial intelligence for preoperative planning in surgery

In surgery, artificial intelligence (AI) is applied mostly in imaging, navigation, and robotic intervention. However, AI can also play a major role in preoperative planning. Objective decisions-making, optimal utilisation of operating theatres and less overtime are additional advantages that are achieved with the use of AI in surgery.

Surgeons make complex, high-risk decisions with significant impact on patients' lives, usually under time pressure. The multitude and variability of diagnostic data and the potential dangers of a surgical intervention pose tough challenges for the staff. Therefore, thorough pre-operative planning, in which surgeons prepare the operation based on medical records, historical methods and data, is essential for the success of a surgery.

Decision-making systems

Surgeons decide based on their training, experience, and knowledge, so their judgement or bias can influence them. Decision-making systems based on AI have the potential to overcome these limitations. These systems enable the processing of many patient data sets, which can be transferred into mathematical models and enriched with background knowledge to recommend or advise against a certain therapy.

Artificial intelligence is used as a decision-support tool with two tasks: to compensate for the different levels of knowledge and experience of surgeons by objectively and individually analysing patient data; and highlighting clinically relevant correlations that the physicians may not recognise.

For example, scientists at Heidelberg University Hospital are developing a 'Cognitive Medical Assistant' (KoMed). The aim of the project is to recognise patterns from laboratory results, image data, diagnoses, and therapies and to identify correlations that can create individual risk profiles. The algorithm should identify a patient's surgical risk before an operation, facilitate therapy decisions and prevent complications. Specifically, the algorithm is designed to predict the likelihood that patients will need a blood transfusion.

In another study, researchers used deep learning to predict kidney failure, mortality and post-operative bleeding after heart surgery. With their approach, the scientists achieved superior results compared to standard clinical reference tools.

Limitations

Clinical trials in AI-assisted surgery with evidence are scarce, and AI-assisted decision support has yet to realise its potential. Currently, decision support applications are limited to risk stratification of surgical treatment or its complications. In surgical oncology, AI studies are mainly limited to the feasibility of predicting oncological outcomes, postoperative complications and predicting mortality and survival.

For now, only a few comparative studies focus on improving treatment decision-making. Commercial attempts to address this problem have struggled with various issues. IBM Watson for Oncology Cognitive Computing System drew on data, test cases and experts at Memorial Sloan Kettering Cancer Center to generate treatment recommendations. However, studies have so far shown little consistency between Watson's treatment recommendations and actual surgical treatments. Google's DeepMind, on the other hand, was criticised for its lack of transparency and problems with data protection.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AI in surgical planning can improve the treatment pathway.

OR planning

Scheduling operations, assigning patients, surgeons, nursing staff and anaesthetists – surgery planning in hospitals is a dynamic, complex, and time-consuming undertaking. Emergencies, staff absences or unforeseen events during a procedure are common short-term events that can quickly upset the schedule. Even for experienced OR managers, exact planning or possible manual adjustments are therefore difficult. The results are not only suboptimal utilisation of operating theatres and thus of resources but also inflict additional strain on staff.

Assistance management systems that schedule staff, treatments, times, resources as well as upstream and downstream processes around the operating theatre with the assistance of AI could provide a remedy. Based on the collection and analysis of data, these systems create a scheduling plan according to definable criteria, evaluate what is happening and adjust the plan in real time if unexpected events occur.

A stable OR plan not only relieves staff in the long term by eliminating shifts and overtime, but also increases treatment quality because the staff has more time to care for the patients. Optimised capacity also pays off for a hospital's economic situation by enabling better scheduling of staff and bed occupancy. In the 'KIOM' project, researchers are developing an interactive AI-supported assistance system for efficient planning of operations. It is intended to interactively support OR managers in scheduling surgeries. The combination of mathematical optimisation approaches with AI methods generates stable and transparent OR plans.


© CASSANDRA project

AI-assisted anaesthesiology.

Anaesthesiology

Many studies test AI applications for anaesthesiology in clinical settings. The aim is to predict potential complications with a personalised perioperative therapy and to sustainably improve the postoperative outcome of patients.

In the Cassandra project, researchers are developing and evaluating a virtual 'AI team member' to support anaesthesiologists in the treatment and care of patients. Also, they aim to reduce the time and mental burden on staff and improve documentation quality through automatic documentation. In addition, researchers are exploring the potential for AI to control the mechanical ventilation of anaesthetised patients. Other trials study how the AI can automate weaning from ventilation.

Further areas of application involve AI-based estimation of the correct opioid dosage and the identification of patients who could benefit from pre-operative counselling by a hospital's acute pain service.

Many AI software developments and studies on their applications show improvements over existing methods. But the hype around AI can lead to unrealistic expectations and disappoint clinicians and patients. Assistance and decision-making systems can give hospitals greater planning certainty and improve surgical outcomes, but operators should use them in the right situation to solve a specific problem. The examples of IBM and Alphabet show how complex the integration of AI systems into the clinical workflow can be. ■

Report: Sascha Keutel