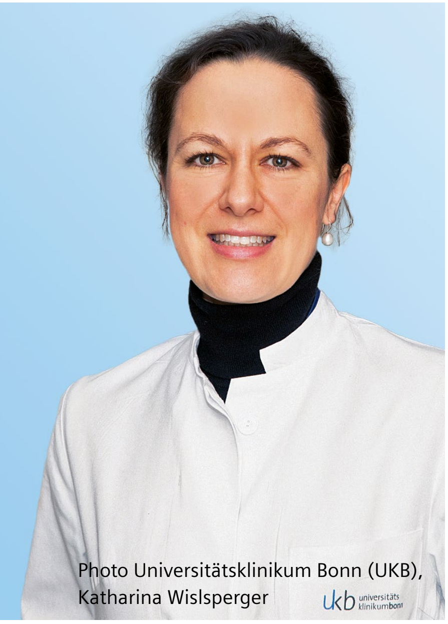


Photo Universitätsklinikum Bonn (UKB), Katharina Wislsperger

Professor Ulrike Attenberger, M.D., is Chair of the Clinic for Diagnostic and Interventional Radiology at University Hospital Bonn in Germany, and Head of the KI.NRW flagship project, Innovative Secure Medical Campus UKB.

Dr. Attenberger was a resident at the Institute of Clinical Radiology at University Hospital Munich (LMU) Grosshadern, Germany, between 2005 and 2008. She then spent a year as a resident at the Institute for Clinical Radiology and Nuclear Medicine, which is part of Medical Faculty Mannheim at Heidelberg University, Germany. After her residency, she remained at the institute, taking a position as Senior Physician for the MRI Division. This was also the year she qualified as a radiologist. In January 2011, Dr. Attenberger became Senior Physician and Section Chief of the Preventive Diagnostics Division at the institute. In January 2013, she became Section Chief of the Oncological and Preventive Diagnostics Division. In March 2013, Dr. Attenberger was appointed Vice Chair of Clinical Operations. She took up her current position at University Hospital Bonn in December 2019.

In addition to these roles, Dr. Attenberger holds an adjunct professorship at the Medical University Vienna, Austria. Between 2012 and 2015 she was visiting professor at the A. Martinos Center for Biomedical Imaging and Massachusetts General Hospital, Harvard Medical School, Boston, MA, USA; in Zurich, Switzerland, and in Vienna, Austria. She has also received several awards, including the Fellow Award of the Radiological Society of North America in 2010 and the Walter Friedrich Prize, awarded by the German Society of Radiology, in 2012. In her work today, Dr. Attenberger seeks to improve diagnosis and treatment for patients. With this goal in mind, she primarily focuses on using artificial intelligence to characterize diseases and tailor therapies to individual patient needs.

Leading through change

Point of departure

Healthcare today must address a number of significant challenges: Demographic change is leading to a steady rise in the number of multimorbid patients with complex diseases that require a high level of care and therapy, but the number of specialists available to treat them is comparatively low. At the same time, the innovation cycles of medical technologies are becoming shorter. Combined with the (demographically driven) fact that fewer people are actively paying into health insurance funds, this is creating palpable cost pressure in the system. Despite this strained situation, providers still need to maintain access to care for all with the guarantee of a quality-assured, patient-centric healthcare system.

Digitalization and artificial intelligence appear to be the most powerful methods of alleviating the strain. Digitalization is crucial to creating more efficient processes in daily clinical workflows by optimizing the way in which existing resources are used. It is also the foundation for developing AI algorithms. Without digital data, we cannot continue using AI.

Transformation of healthcare

What is more, the healthcare system itself is on the brink of a transformation. It is moving away from a model where a single expert studies and cognitively merges individual data, toward precision medicine where AI methods are used to achieve a fully integrated assessment of all data (lab, genomic, imaging, and clinical) gathered in the treatment context. The aim of this model is to do more than simply detect diseases; it is about characterizing, or rather phenotyping them more accurately in order to predict therapy response and outcome. A 2019 analysis by Roland Berger identified digital monitoring and AI diagnostics as the two leading technologies that would have a significant impact on diagnosis and therapy by 2025 [1].

PwC goes a step further and predicts that the next decade will see a shift from real-time, outcome-based care driven by wearables, big data, and healthcare analytics, to preventive care founded on robotics, AI, and augmented reality [2].

If we were to put a ruler against these developments, some of which are already underway, and hypothetically extrapolate them, the outcome would show that we will probably all be part of an AI continuum in future. All our clinical, lab, imaging, and genetic data will be integrated into multisource data models, on which disease pathways and clinical decision support systems will be developed. When a person falls ill, their individual situation will be compared with global databases to identify the best possible therapy for the individual and their pathology. Perhaps our digital twin will one day remind us that it is time to make an appointment with our primary care physician.

Before that day comes, we need to find comprehensive answers to the data-protection, legal, and ethical questions. We must also address the challenges of structured data storage (in data lakes, data repositories) and interoperability, including across national borders.

Advancements in imaging technology

One major issue in multisource data models is imaging. Image data are a major input for multisource data models. It is therefore more relevant than ever that we continue to advance imaging technology in terms of the robustness and speed of data acquisition and its ability to generate multiparametric, morphological, and functional information for improved disease characterization. Major technologies of recent years include photon-counting technology, which we expect to deliver optimized tissue characterization, among other things. Then there is high-gradient imaging technology (MAGNETOM Cima.X), which lays the technical groundwork for gaining a more detailed view of the microstructure of tissues by using linear multiscale modeling [3], for instance, and makes this available for clinical as well as purely research applications. In addition, smart AI-based reconstruction algorithms like Deep Resolve Boost can significantly reduce image acquisition time, even for time-consuming exams such as whole-body diffusion MRI, without any loss in image quality. Achieving standardized high image quality is an essential requirement for AI imaging models, especially in MRI.

Yet, in view of the urgent healthcare challenges that I outlined at the start, it is not (or no longer) sufficient to use high-end imaging technologies as a stand-alone solution, or to solely optimize radiological workflows and processes. The healthcare system of the future requires a holistic approach that goes far beyond individual technologies and incorporates a broad range of blended solutions – although imaging will undisputedly still play a leading role.

Digitalization and AI in hospital operations

To maintain the quality of medical care at its current high level while also continuing to refine it to meet the requirements of precision medicine, all data must be fully digitalized. This requires a seamless exchange of treatment-related patient information both inside hospitals and with external referring hospitals or medical practices. It will guarantee optimal data availability, which in itself will improve processes and raise efficiency, simply because it will save staff time by removing the need to search for information. Another significant aspect in this context is the use of AI to optimize internal hospital processes for diagnostics and therapy to enable efficient use of expensive large equipment and OR infrastructure, as well as efficient shift planning for staff, particularly those who are highly specialized. Solutions include systems for AI-based patient routing and staff shift planning, remote scanning and remote surgery technologies that can cover gaps in staffing, and robotic systems that can provide care and lift patients to relieve the burden on radiology technologists and nursing staff. From a radiological perspective, this must also include simplifying complex examinations such as cardiac imaging. The 3D Whole Heart collaboration initiative is testing interesting approaches to optimize workflows in this context. This can achieve efficiencies that lead to better scanner utilization and therefore a reduction in waiting times.

Communication and collaboration

Communication processes, such as those within full-service university hospitals, also need to be improved to save time that can then be invested in patient care.
Patient dashboards and Google communication tools, for instance, could enable more efficient and targeted communication. One potential area of application would be ad-hoc tumor boards.

Building structured databases makes it possible to develop AI-supported clinical-decision support systems. This provides the foundation for data-based treatment of even extremely ill patients or those with complex diseases. These data are also the basis for developing digital twin models that enable AI-based simulations of possible therapies. When combined with real-time collaboration in extended reality environments, digital twins will also provide many benefits when it comes to planning and carrying out surgeries. They will also support patient communication by helping patients understand complex syndromes or therapies. The visual clarity provided by virtual reality means the technology could be used to improve training for students, physicians, radiology technologists, and nurses. When used in the OR or the interventional suite, virtual and extended realities can also optimize navigation to enable greater therapeutic precision.

Cybersecurity and patient education

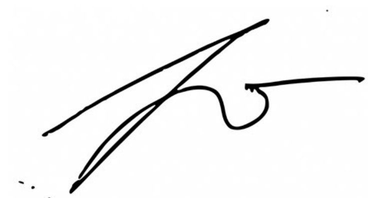
With all this said, we must not lose sight of two key aspects: As healthcare becomes more digital, it will increasingly become a target for cyberattacks. Sensitive and personal data must only be accessible to people who genuinely need to see this information. To achieve this, the data will be stored in extremely secure environments and monitored to protect them from potential threats. This is why it is crucial to consider and implement cybersecurity from the outset – for instance, by setting up special cyber-defense centers that can monitor healthcare facilities worldwide to identify cyberattacks in real time.

In addition, patients must be fully informed. Achieving broad acceptance for digitalization and AI relies on patients being able to develop a deep understanding of the advantages and possible risks of the technology. There are doubtless major differences on this matter worldwide. Within Europe, it is definitely a topic that still requires a great deal of public attention and education.

Future outlook

However fascinating the potential of digitalization and AI in healthcare may be, we must keep in mind that all stakeholders – full-service university hospitals, regular-service hospitals, medical practices, care facilities, and patient associations – must pull together to make this vision a reality.

Full-service university hospitals can surely play a pioneering role here by testing new approaches and developing proof-of-principle concepts for the extent to which digitalization and AI can really provide tangible relief for hospital staff. They can trial a shared database with maximum interoperability for all participating facilities, and they can ensure that patients are included in digital processes. We would expect this to lead to a better use of staff and equipment capacities, which could address the shortages of specialists. We would also expect a reduction in waiting times and the duration of hospital stays through AI-based coordinated scheduling for patients and an optimized flow of information within the facility and externally with stakeholders such as referrers. Ultimately, success depends on the willingness to collaborate and on everyone involved sharing a common goal.



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References

1 Roland Berger. Future of health: An industry goes digital – faster than expected. October 2019. Accessed on October 16, 2023. https://content.rolandberger.com/hubfs/Roland-Berger_Future-of-health.pdf
2 PwC. Sherlock in Health: How artificial intelligence may improve quality and efficiency, whilst reducing healthcare costs in Europe. June 2017. Accessed on October 16, 2023. https://www.pwc.de/de/gesundheitswesen-und-pharma/studie-sherlock-in-health.pdf
3 Wichtmann BD, Fan Q, Eskandarian L, Witzel T, Attenberger UI, Pieper CC, et al. Linear multi-scale modeling of diffusion MRI data: A framework for characterization of oriented structures across length scales. Hum Brain Mapp. 2023;44(4):1496–1514.

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