# RESEARCH NEWS

**Safe, efficient healthcare**

## 5G in the OR: Advances in Technology Unlock Opportunities for Hospitals

**How can surgery be made more cost-effective, safer and more efficient in the future? An interdisciplinary French-German team has developed high-tech hybrid operating rooms that harness the power of 5G and AI to unlock whole new applications.**

A medical emergency requires complicated surgery. But the closest specialist is hundreds of kilometers away. These days, this kind of situation could be a life-or-death issue, but just a few short years from now, surgeons might be able to operate on patients remotely, with support from a robot with haptic feedback. The hospital would operate its own 5G network, ensuring low-latency connections to exchange data continuously during the operation. Researchers worked on these and other scenarios in the 5G-OR (Establishing the next generation of a **5G**-enabled **o**perating **r**oom ecosystem to improve patient outcome) project, which has just concluded.

"These days, economic pressures mean that hospitals are forced to build efficient new infrastructure and processes while also finding fresh new ways to use technology to connect and share data," says Johannes Horsch, a project manager working in health technology research at the Fraunhofer Institute for Manufacturing Engineering and Automation IPA at the Mannheim location. "The French-German project 5G-OR, which brings public and industrial research together, addresses both aspects." It is supported by the Federal Ministry for Economic Affairs and Climate Action.

A Roland Berger survey conducted in July 2024 showed that seven out of ten hospitals in Germany posted losses last year. In addition to consolidating their services and modernizing their infrastructure, many hospitals view collaboration and mergers as an especially important building block in putting themselves on a secure financial footing now and for the future. Shortages of healthcare professionals present another challenge.

**Hybrid high-tech operating rooms in Germany and France**

The 5G-OR project brought engineers, entrepreneurs, surgeons and anesthesiologists together across national borders at three locations: Mannheim, Berlin, and Strasbourg. The experts developed three high-tech hybrid operating rooms with intraoperative imaging systems. Aside from Fraunhofer IPA, the project also involved the Institut Hospitalo-Universitaire (IHU) in Strasbourg on the French side, in Germany Charité — Universitätsmedizin Berlin, Reutlingen University, SectorCon GmbH, and KARL STORZ SE & Co.

KG, the private French research and technology institute b<>com, and the French start-up Rhythm Diagnostic Systems, otherwise known as RDS.

"The team's main objectives are to lower the rate of complications arising from medical procedures and streamline workflows in the OR. Medical errors still occur in some eight to twelve percent of all hospital stays today," Horsch explains. "The introduction of 5G technology enables secure, flexible and reliable wireless communication and the exchange of data through a powerful data pipeline. This level of connectivity reduces errors and enhances efficiency." Artificial intelligence (AI) is used to analyze data more effectively during surgery and support the use of robotics in medicine. Prof. Sascha Treskatsch, head of the Department of Anesthesiology and Intensive Care Medicine at Charité, Campus Benjamin Franklin, also believes in this research from the user side: "Processing large volumes of multimodal data records in real time will revolutionize patient monitoring and thus therapy in clinical settings, and especially in the operating room during anesthesia. 5G-OR is the basis for this."

The international team put four relevant applications into practice as part of the project:

- **AI-assisted monitoring of vital signs**: Patients wear a smart patch throughout treatment, from the operation through to follow-up care at home. Sensors in the patch track vital signs and communicate them wirelessly to a monitored platform, where they are analyzed using AI. This makes it possible to detect potential complications early on. 5G-OR is also laying the foundation for a completely new kind of high-frequency data processing in real time, which will enable widespread use of AI.

- **AI-supported analysis of surgical data**: During the operation, AI can be used to analyze endoscopic images or video sequences, for example, along with data from surgical instruments and processes. In this way, the progress of the operation can be determined and potential anomalies or risks identified. These kinds of analyses also streamline workflows in the operating room.

- **Robot-assisted telesurgery**: High-tech operating rooms allow surgeons to operate on patients remotely, with support from a robot with haptic feedback. 5G ensures high bandwidths for the huge volumes of data involved, along with a low-latency connection for exchanging data in real time during the operation. Especially in light of the wave of consolidation sweeping hospitals across Germany, this application can help in emergencies when specialists are not available locally. The system can also be used locally outside the OR, for example to protect medical staff from risks such as X-ray radiation or infections.

- **Mobile robotic support in the operating room**: A mobile robot developed specifically for OR settings transports medical supplies and instruments. It eases hospital staff workloads by handling logistical tasks during the operation. Methods long ago adopted in industrial factories require the utmost in accuracy, safety, flexibility and

reliability when used in an operating room. Campus-wide 5G networks make this a reality by providing data in real time.

The focus now is on transferring these applications and technologies into clinical practice. This includes extensive testing, reviews of medical approvals, and finding paths to market through industry partners and start-ups. The project team also plans to expand the network. Their aims here are twofold: to get broader user feedback on the one hand and strengthen international collaboration on the other. "Close collaboration between Germany and France within the project is not just important. It's vital," Horsch says. "Through these efforts, we are enabling the cross-border exchange of data and accelerating international consensus on the use of AI in operating rooms. In this way, 5G-OR is contributing to advances in surgical practice and to improving patient safety in Europe."



**Fig. 1      The mobile robotic platform developed by Reutlingen University together with Fraunhofer IPA in the experimental OR in Strasbourg enables the autonomous transport of medical material and instruments.**

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**Fig. 2      In the experimental, networked hybrid OR at Fraunhofer IPA in Mannheim, 5G enables data transfer in real time.**

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