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POWERING THE WORLD'S MOST IMPORTANT DEVICES

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Transforming the Operating Room: AI-Powered Surgical Devices and the Future of Procedural Precision

Artificial Intelligence (AI) is driving a monumental shift in how surgical procedures are executed, visualized and managed. Rather than merely enhancing individual surgical devices, AI is reimagining the entire operating room (OR) as a connected ecosystem. With the advent of edge AI technologies, new platforms enable intraoperative intelligence, real-time data processing, and enhanced visualization – setting the foundation for safer, more efficient and more effective surgeries.

Hospitals that invest in AI-enabled solutions realize not only better patient outcomes but also stronger financial returns due to increased throughput, optimized workflows and reduced complications. For OEMs, AI represents a chance to create category-defining devices that offer meaningful clinical advantages. Medical device manufacturers can take advantage of this opportunity by embedding scalable, affordable, and power-efficient AI into their solutions using Intel® Core™ Ultra and Intel® Xeon® processors – no discrete GPUs required.

This solution brief explores the challenges, opportunities and technologies shaping the next generation of innovation across key device categories: surgical cameras, three-dimensional (3D) cardiac mapping devices, surgical robotics and OR Integration hubs.

The OR is one of the most data-rich environments in healthcare. AI and edge computing technologies now allow that data to be captured, interpreted, and used in real time to improve outcomes, reduce risks, and enhance the overall surgical experience.

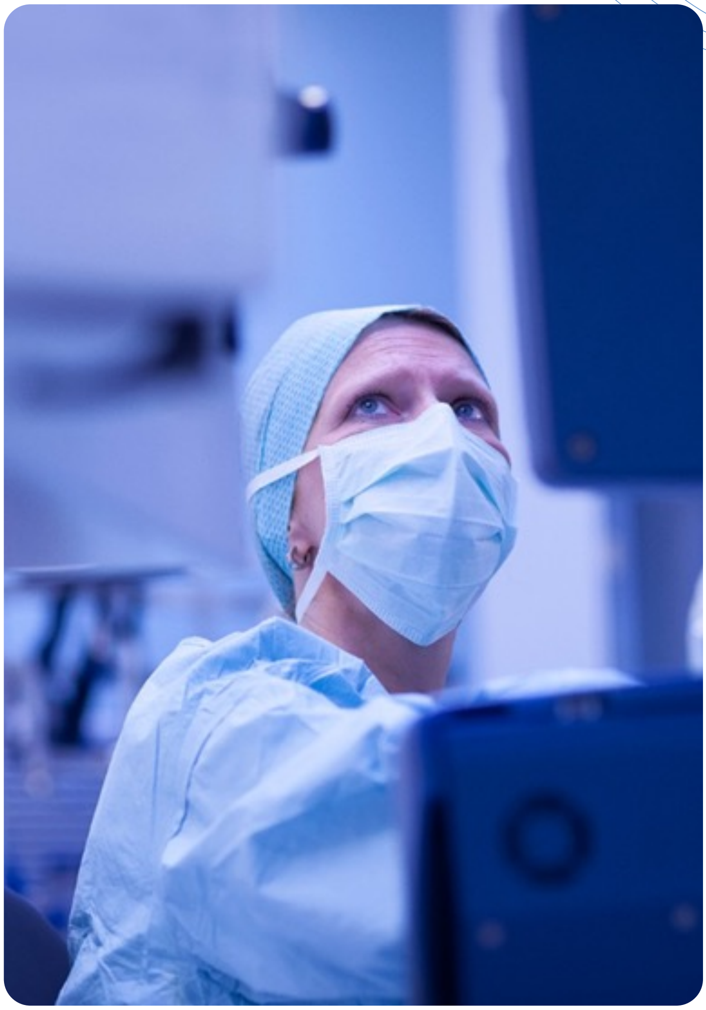
Core Challenges in the OR

Despite decades of innovation in surgical tools, many core challenges persist within the operating room (OR). Limited real-time insight can hinder precision, especially in minimally invasive procedures. And, in trauma settings, surgeons can be working long shifts, possibly under fatigue. As modern ORs grow more technologically complex, legacy compute systems often struggle to keep pace with advanced imaging, AI, robotics and infrastructure demands. Administrative tasks also present a challenge – manual or delayed clinical documentation increases the likelihood of errors and consumes valuable clinician time.

Key Trends Driving Change

Three macro trends are fueling demand for AI-powered surgical solutions:

- **Minimally Invasive Surgery (MIS):** MIS adoption is accelerating, driven by shorter patient recovery, lower complication rates, and better cost-efficiency. In 2023, MIS procedures rose 7% (1), and the market is forecasted to reach $228.85 billion by 2032 (2). AI is key to advancing MIS by supporting hyper-personalized treatments with surgical planning technologies, agile surgical tools, and real-time visualization for precise surgery in challenging physiologies and smaller surgical fields.
- **Rise of Edge and Physical AI:** Edge AI enables real-time inference without relying on continuous cloud connectivity. Semiconductor innovations allow powerful AI inferencing models to run at the edge on Intel® Core™ and Intel® Core™ Ultra processors. By processing workloads near the surgical device and point of care, edge AI improves latency and enhances privacy and streamlines clinician workflow.
- **AI as a Differentiator:** OEMs are under pressure to build smarter, more capable devices that augment surgical teams and give them tools and analysis to perform at their best and improve patient outcomes. Offering real-time overlays, guided procedures and voice-controlled automation delivers meaningful competitive advantage.



(1) Source: Annals of Surgery Open
(2) Source: SNS Insider

Intel® and Dedicated Computing: Enabling the Future of Surgical Devices

Surgeons increasingly adopt compute-intensive applications such as 3D mapping, real-time video enhancement, and AI-based decision support to enhance precision and workflow efficiency. Edge computing platforms are now enabling these advanced capabilities directly in the OR, eliminating latency delays associated with cloud-based processing and allowing for rapid, data-driven decision-making.

Intel and Dedicated Computing deliver the performance, efficiency, and flexibility medical device OEMs need to power next-gen surgical platforms. Whether you're building compact, AI-ready surgical cameras or robust 3D mapping systems, Intel's silicon, software, and security capabilities are ready to support your innovation.

Intel's edge solutions provide a competitive advantage for leading medical equipment manufacturers by leveraging both existing Intel architecture and the latest generation AI chips, such as NPUs. This enables the delivery of AI-enabled solutions at a lower bill of materials (BOM). Many customers are utilizing CPUs to run AI inference algorithms directly on the device, eliminating the need for discrete, power-hungry and expensive graphics cards. Additionally, Intel's technology is highly compatible with other systems, ensuring that it can meet diverse customer needs.

1. Surgical Cameras

Used in: Overhead OR camera views, surgeon cameras, surgical robotics, endoscopy, laparoscopy, colonoscopy, arthroscopy and other minimally invasive procedures

Challenges: Surgical cameras must deliver high-quality, low-latency video streams under strict power and thermal constraints. Maintaining AI model performance across varied lighting, tissue types and procedural movements adds complexity. Integration with legacy camera hardware and the need for compact, quiet systems further complicate design.

Intel + Dedicated Computing Value: Intel® Core™ Ultra provides an efficient solution with integrated graphics and NPU capabilities. Its many built-in camera interfaces allow direct input of high-resolution camera feeds without the need for discrete PCIe cards, reducing system cost and size. Combined with Intel® Distribution of OpenVINO™ Toolkit, developers can deploy AI models for visual enhancement, anomaly detection and procedural guidance right at the edge.

OEMs benefit from reduced bill-of-materials costs, simplified integration, and the ability to support AI workloads in compact devices suited for carts, towers or embedded medical environments.

Recommended Tech: Intel® Core™ Ultra, Intel® Distribution of OpenVINO™ Toolkit

2. 3D Cardiac Mapping Devices

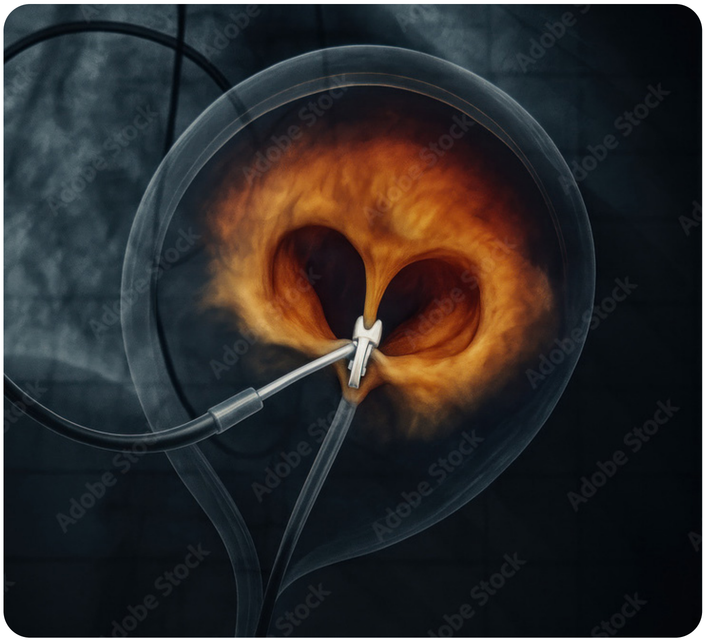
Used in: Catheter-based ablation procedures for diagnosing and treating cardiac arrhythmias, especially atrial fibrillation (AFib)

Challenges: These devices require high-throughput data processing for 3D anatomical reconstruction, simultaneous electrophysiological data visualization, and precision overlay of real-time ablation paths. The compute burden is significant, especially when rendering in real time and managing multiple input sources from sensors, scopes and control systems.

Intel + Dedicated Computing Value: Intel® Xeon® Scalable Processors deliver the high-frequency, multi-core performance required for electrophysiological data processing, while Intel® Advanced Matrix Extensions (Intel® AMX) accelerate matrix math vital to 3D rendering. With support for graphics display and OpenVINO™ for AI integration, these platforms are well suited for next-generation electrophysiology lab systems that demand speed, accuracy and responsiveness.

Dedicated Computing hardware provides modular scalability and robust thermal profiles needed in high-performance mapping devices, while the company manages the long lifecycles needed in medical equipment.

Recommended Tech: Intel® Xeon® Workstations, Intel® AMX, OpenVINO™ Toolkit



3. Intracardiac Echocardiography (ICE) Systems

Used in: EP ablation, left atrial appendage closure (LAAC), tricuspid valve repair and structural heart interventions

Challenges: ICE delivers critical real-time ultrasound images, but interpretation requires significant training and expertise. Smaller facilities often lack access to experienced imaging professionals. Interpretation challenges also contribute to longer procedures and higher error risk.

Intel + Dedicated Computing Value: Intel® Xeon® platforms can run AI inference models at the edge to label anatomical structures in real time, reducing the need for on-site specialists and enabling broader access to high-quality care. These AI overlays improve decision-making and streamline workflows. Paired with OpenVINO™, solutions can support customizable models for different procedure types and physician preferences.

Dedicated Computing platforms ensure low-latency performance and can be deployed in both portable and rack-mounted ICE systems, expanding deployment flexibility for OEMs.

Recommended Tech: Intel® Xeon®, OpenVINO™ Toolkit

4. Surgical Robotics

Used in: Robotics-assisted minimally invasive surgery (MIS) across various specialties, including urology, gynecology, orthopedics, and general surgery

Challenges: Surgical robotics systems require precise control and coordination across sensors, instruments, haptics, and vision systems. These devices need real-time AI to interpret anatomy, recognize instruments, and adapt to surgical contexts. Maintaining sub-millisecond latency and deterministic response is vital.

Intel + Dedicated Computing Value: Intel® Xeon® and Core™ Ultra processors enable real-time inference and motion control across robotic arms and vision systems to support complex, time-critical compute demands. AMX and integrated GPUs accelerate sensor fusion and object recognition tasks. These platforms also offer security and manageability tools to meet rigorous regulatory and reliability demands.

Dedicated Computing's compute platforms offer ruggedized performance, thermal flexibility, and validated integrations to support FDA and CE marking pathways. OEMs can iterate faster with proven hardware and a robust AI toolchain.

Recommended Tech: Intel® Xeon®, Intel® Core™ Ultra, Intel® AMX, OpenVINO™ Toolkit

5. OR Integration Hubs

Used in: Centralized control systems for video routing, imaging devices, surgical lighting, telemetry, and environmental controls in the OR

Challenges: OR integration hubs must manage diverse inputs and outputs, often across multiple vendors and protocols. These systems need real-time responsiveness, high-bandwidth data handling, and uncompromised uptime to support clinical efficiency and safety. This is also where AI workloads are being run for OR analytics and optimization, with cameras that track breaches in sterile field, to visual AI surgical guidance and notetaking. There's immense power and possibility in the OR integration hub.

Intel + Dedicated Computing Value: Intel platforms offer rich I/O capabilities, virtualization support, and scalable edge AI processing to handle multi-device orchestration. Features like Intel® TDX and SGX protect sensitive data streams from breaches or tampering, supporting HIPAA and international security compliance.

OEMs can build plug-and-play solutions that interoperate with hospital IT infrastructure while supporting future AI upgrades via modular, long-lifecycle hardware platforms from Dedicated Computing.

Recommended Tech: Intel® Xeon®, Intel® Core™ Ultra, Intel® Trust Domain Extensions, Intel® Software Guard Extensions

Advantages of Using Intel and Dedicated Solutions

For medical device equipment manufacturers, the integration of edge AI into surgical platforms presents an opportunity to lead in both innovation and outcomes. These systems can help streamline development by offering modular compute platforms and optimized AI toolchains, accelerating time to market, depending on integration strategy. Medical equipment manufacturers can reduce development costs by replacing high-power discrete GPUs with integrated AI accelerators, such as those found in Intel's Xeon® and Core™ Ultra platforms.

Beyond performance and efficiency, AI-enhanced devices offer a compelling differentiator in a competitive marketplace. By delivering better visualization, more intuitive workflows and higher procedural efficacy, OEMs can create devices that attract surgical teams and hospital systems seeking advanced, outcome-driven technology. For example, electrophysiology (EP) labs may prefer a platform that supports AI overlays and real-time analysis, giving clinicians the confidence to work more efficiently and precisely.

Furthermore, interoperability with existing hospital systems ensures smooth integration into complex OR environments. Dedicated Computing platforms support legacy systems while enabling future scalability, backed by long-term lifecycle and compliance support. OEMs gain a path to innovation without sacrificing reliability or regulatory alignment.

Ultimately, edge AI empowers OEMs to deliver market-leading devices that address real clinical challenges while advancing procedural safety, speed, and personalization.

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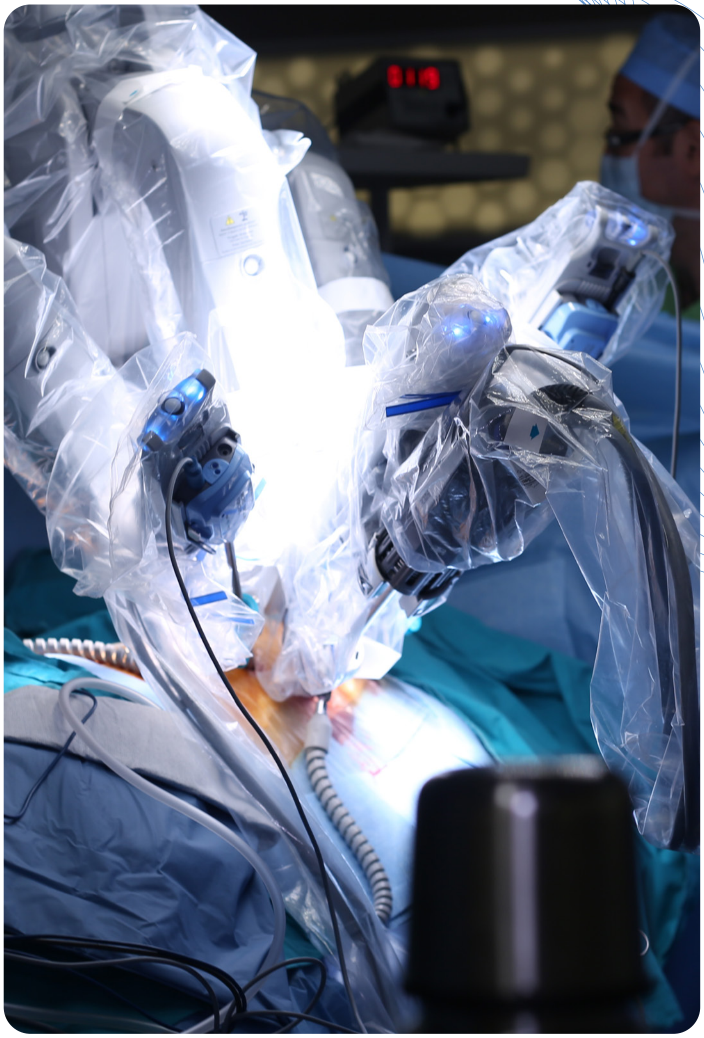
You don't need discrete GPUs to run AI at the edge.

For makers of surgical cameras, Intel and Dedicated Computing platforms deliver cost-competitive performance without requiring additional discrete GPUs. Security is built into the hardware stack, meeting stringent medical compliance standards.

Long lifecycle support ensures that OEMs can design devices with longevity in mind, minimizing redesigns and regulatory requalification.

In addition, strategic partnerships bolster the solution's robustness, providing plug-ins for video enhancement, ultra-low latency I/O, and scalable sensor data processing.

Conclusion: Powering the Next Generation of Surgical Innovation



Edge AI enables more efficient procedures, allowing surgical teams to operate at the top of their skillset and improve performance and patient outcomes. This efficiency translates into stronger return on investment - minimally invasive, AI-supported procedures demand fewer resources, free up recovery beds more quickly and reduce strain on hospital infrastructure.

Clinically, the benefits to patients are just as compelling. Enhanced visualization, precision guidance and real-time analytics enable faster, less invasive interventions. As a result, patients experience shorter surgeries, faster recovery times, and improved outcomes with lower risks of infection or readmission.

Intel and Dedicated Computing are empowering OEMs to develop a new generation of surgical devices - smarter, smaller, and more interoperable than ever before. From visualization to robotics to intraoperative AI, we help you build the future of surgery.

Next Steps: Contact Dedicated Computing to explore surgical platforms powered by Intel® or to request a solution consultation.

About Dedicated Computing

Dedicated Computing is an ISO 13485:2016 and ISO 9001:2015 certified global technology company committed to solving the business problems of our customers through the design, development, and deployment of innovative technology solutions. We design and build advanced computing systems for powering complex applications, machine learning, and AI at the edge. Dedicated Computing's systems are integrated hardware and software platforms that are optimized to meet the specific computational and performance needs of OEM applications.

About Intel's Healthcare and Life Sciences Team

Intel designs and manufactures advanced semiconductors that power and connect the modern world, shaping the future of computing and enabling new possibilities globally.

Intel partners across the healthcare and life sciences ecosystem with medical equipment manufacturers, channel partners, software innovators, researchers, laboratories, and hospital systems to address unique industry challenges and deliver innovations that improve patient outcomes and operational efficiency.

We enable intelligent medical imaging from ultrasound to MRI and CT scans, while advancing AI-driven patient monitoring. In operating rooms, Intel powers surgical robotics and endoscopy for more efficient procedures. Across life sciences, we accelerate lab automation and research through digital pathology, microscopy, and screening tools. Our processors drive AI workloads at the edge using computer vision and sensor integration, while our open-source tools accelerate partner innovation across the healthcare and life sciences ecosystem.

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