intel.

Anatomy of a Smart Hospital: Intelligent, Connected, Secure

Intel® technologies are powering a new generation of smart hospitals, delivering the intelligence, security, and connectivity needed to modernize processes and transform patient care.

Intel® technologies help smart hospitals enable multimodal spatial awareness, multiaccess edge-native cloud, and AI everywhere.

Building a foundation for the next era of healthcare

The smart hospital concept is poised to transform healthcare. It can address many of the critical pressures that are impacting providers and hospital management. From making sense of the flood of patient data to maintaining expanding fleets of complex medical devices, Intel and our ecosystem of solution partners are making the smart hospital a reality.

Driving these developments are technologies that enable artificial intelligence (AI) everywhere, multimodal spatial awareness, multi-access edge-native cloud, and edge-to-cloud capabilities. Together, we are finding ways to help improve provider productivity and patient outcomes while helping to reduce costs and downtime.

Delivering intelligence, connectivity, and security

Healthcare technologies are rapidly advancing, bringing new life-saving diagnostics and treatments to patients everywhere. Medical imaging and other workload-intensive applications are generating unprecedented volumes of data. This data must be securely stored, analyzed, and accessed enterprise-wide, from the edge of the hospital network to the cloud.

AI and analytics are increasingly being embedded in medical devices and clinical applications. This is enabling faster, more-precise diagnostics and more-informed decision-making. However, even as hospitals continue to benefit from new advances in healthcare technologies, these smart point solutions are often disconnected from each other. This leads to isolated data silos, workflow bottlenecks, and disjointed clinical user experiences.

To address these technological challenges, a new generation of smart hospitals is fast emerging. By employing extensible technological frameworks, smart hospitals enable workflow agility across healthcare partners, providers, and systems. Today's digital-first institutions are transforming their infrastructure with the seamless integration required to significantly increase connectivity, intelligence, and automation.

Employing digital twins to monitor the state of patients, equipment, and the hospital itself

To more efficiently organize and leverage the data deluge around patients and high-value assets, smart hospitals today are employing a concept known as the digital twin. This approach creates a virtual representation of a system, facility, or even a patient. The virtualized digital twin offers a new level of visibility and creates opportunities for predictive analytics and optimized care. Originally developed for industrial use cases, the digital twin concept is finding widespread applications within smart hospital implementations.

OpenVINO™

Gartner defines a digital twin as "a software design pattern that represents a physical object with the objective of understanding the asset's state, responding to changes, improving business operations, and adding value."

Smart hospitals create digital twins of physical assets by first gathering data generated about a select asset from multiple sources. Predictive and near-real-time analytics are then applied to the data to optimize the asset's maintenance, performance, and utilization. Digital twins can be created for many physical assets within a hospital, including patient monitoring devices, imaging machines, wheelchairs, patient beds, and other vital equipment. The digital twin concept can also be applied to human resources such as doctors, nurses, and orderlies.

This concept can even be applied to patients, enabling highly efficient monitoring and management of their health. This is achieved by aggregating data recorded in EMRs with real-time patient health data gathered from systems and applications involved in that patient's care. The resulting digital twin represents a highly comprehensive and precise model of that patient's health. The patient's digital twin then continuously evolves as new data is fed into the model, with AI inference and machine learning used to analyze data and inform diagnostic and treatment decisions. Using a digital twin, patient monitoring can also extend beyond hospital walls. Advanced mobile and wireless technologies, such as 5G, enable digital twin maintenance to capture a patient's health data even after they return home from the hospital.

Delivering efficient patient care is just one healthcare application for digital twins. Because a smart hospital is also a business, the model can be applied to resource management processes to keep care delivery costs within established capital and operational budgets.

Informing, streamlining workflows through spatial awareness

Digital twins bolster spatial awareness by allowing users to see what is happening, while it is happening. With digital twins, users can build digital frameworks for tracking people and objects within a given physical space. The spatial awareness gained from digital twins can offer near-real-time data analytics and insights on how assets are affecting each other and the clinical scenes they inhabit. Digital twins take in spatial and temporal monitoring data from both autonomous and clinician-empowered feedback loops. As a result, they can deliver highly detailed, dynamic, and comprehensive views of smart hospital operations as they unfold.

Achieving this level of spatial awareness enables hospital personnel to understand what's happening now and predict what might happen next. With multimodal digital twins in particular, hospital IT departments can deploy new software applications without additional instrumentation and extend their applications to support multiple sensor types. Smart hospitals can also expand the utility of their existing edge solutions in a unified fashion.
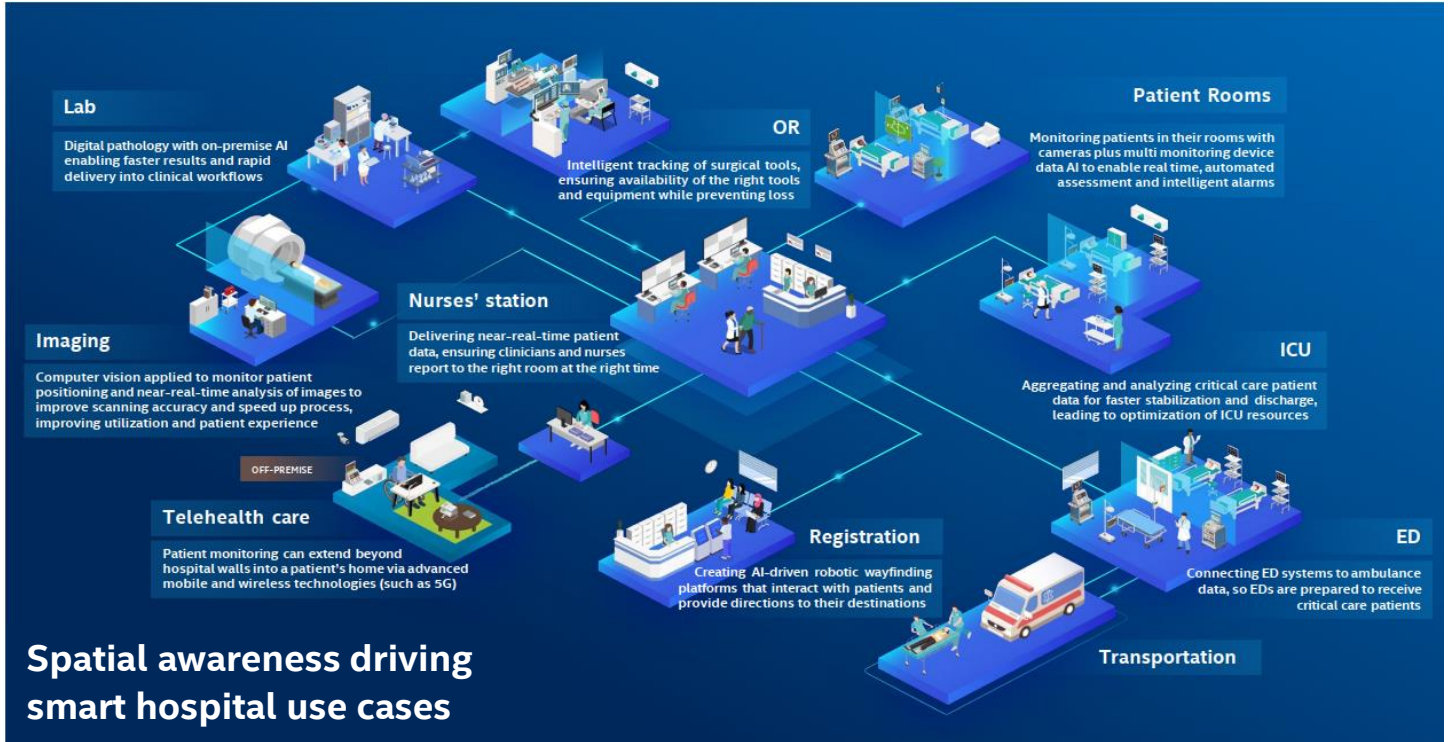
Spatial awareness can measurably improve processes taking place within patient rooms, intensive care units (ICUs), and emergency departments (EDs), yielding widespread benefits.

Having vast amounts of live data available can help clinicians accelerate patient care, reducing the time patients spend in high-value hospital assets such as ED and ICU beds. Analytics-based multimodal monitoring of ICU patients can help fine-tune the performance of highly complex ventilators—or alert personnel earlier when a patient is developing septic shock. Greater spatial awareness in this setting can also drive higher stabilization rates, which means ICU beds can be cleared faster for other critical care patients. As hospitals increase their utilization of revenue-generating assets, they achieve greater cost efficiencies and profitability as well.

Smart hospitals driven by spatial awareness can also improve the efficiency of their nursing rotations. For example, when patient monitoring is enhanced by camera sensors, patients can be monitored around-the-clock, extending the critical coverage of the patient. It can reduce alarm fatigue as well by automating the criticality of various assessments of a patient's condition. Digital twins can leverage real-time location system (RTLS) platforms to keep nurses apprised of where critical assets are located on the floor at any given time. From essential supplies to shared imaging, triage, and crash cart resources, spatial awareness can optimize nursing rotation processes and elevate levels of care.

Spatial awareness enables more-efficient patient flows through the hospital journey as well by delivering the predictive analytics needed to optimize valuable business resources such as waiting rooms and ED triage areas. It can also preemptively redirect patients to different locations within the extended healthcare premises to minimize wait times and improve healthcare experiences.

To help smart hospitals fully leverage digital twins to achieve operational efficiencies, Intel has developed Intel® SceneScape, a software platform for enhanced spatial awareness.

Lab
Digital pathology with on-premise AI enabling faster results and rapid delivery into clinical workflows

OR
Intelligent tracking of surgical tools, ensuring availability of the right tools and equipment while preventing loss

Patient Rooms
Monitoring patients in their rooms with cameras plus multi monitoring device data AI to enable real time, automated assessment and intelligent alarms

Imaging
Computer vision applied to monitor patient positioning and near-real-time analysis of images to improve scanning accuracy and speed up process, improving utilization and patient experience

Nurses' station
Delivering near-real-time patient data, ensuring clinicians and nurses report to the right room at the right time

ICU
Aggregating and analyzing critical care patient data for faster stabilization and discharge, leading to optimization of ICU resources

OFF-PREMISE

Telehealth care
Patient monitoring can extend beyond hospital walls into a patient's home via advanced mobile and wireless technologies (such as 5G)

Registration
Creating AI-driven robotic wayfinding platforms that interact with patients and provide directions to their destinations

ED
Connecting ED systems to ambulance data, so EDs are prepared to receive critical care patients

Transportation

Spatial awareness driving smart hospital use cases

Intel and partners: building the future of healthcare

While smart hospitals are increasing in their operational complexity, they must continue to conform to rigid standards of security, accuracy, and resilience across the myriad technological resources they use to deliver care.

To meet these fast-evolving industry demands, Intel has a large and experienced business unit dedicated to the healthcare market. As a long-time leading provider of compute, networking, and storage technologies used in medical equipment, electronic medical record (EMR) solutions, and picture archiving and communication systems (PACS), Intel has built a broad ecosystem dedicated to advancing healthcare innovations on all fronts.

Intel is continuously working with the world's top healthcare ISVs and systems integrators, as well as providers of medical equipment, cloud services, and communications, to transform the healthcare industry with next-generation systems and applications. Hardware-based security creates a trusted distributed compute foundation to protect connected clinical workloads and data at rest, in use, and in motion across smart hospitals. Intel partners closely with a vast ecosystem of technology and software providers to accelerate the evolution of smart hospitals with a secure, seamlessly connected solution portfolio suitable for the high-stakes operations of patient care.

Inside the Intel-powered smart hospital

Foundational to these healthcare solutions is Intel® SceneScape, a powerful new software platform for spatial awareness, Intel® Distribution of OpenVINO™ toolkit, and industry-leading Intel security® standards and technologies.

Track anything, anywhere with Intel® SceneScape

Intel® SceneScape is a software platform that reaches beyond vision-based AI to realize spatial awareness from sensor data. It transforms data from many sensors to create and provide live updates to a four-dimensional (4D) digital twin of your physical space. Digital twins can be applied to your use cases to look at past analytics, track what is happening in the present, and make predictive decisions for the future.

Within hospitals, Intel SceneScape enables multimodal spatial awareness based on data from multiple different smart hospital sensors. With this software platform, AI is applied to sensor data to infer powerful understandings using technologies like the OpenVINO™, vision accelerators, simultaneous location and mapping (SLAM), and other high compute workloads. This rich data is then transported via the network for near-real-time controls and edge intelligence. This data is used to deploy and update the 4D digital twin, so next-generation smart hospitals can better asses what is happening, while it is happening.

Intel SceneScape can be used to track many use cases within a single hospital to create a digital fabric of interconnected intelligent scenes. This ability to track multiple use cases within one space, eliminates the need for several individual point solutions and thus prevents data from being siloed.

AI everywhere with Intel® Distribution of OpenVINO™ toolkit
Edge intelligence optimized with the OpenVINO toolkit is key to deriving the 4D semantic scene graph from raw sensor data from cameras, patient monitoring, and imaging devices. This converged data pipeline is used to power scene intelligence throughout the smart hospital. While there are many sensor types supported by Intel SceneScape, vision is an important sensor and applicable to most applications.

The toolkit streamlines the development of human-like vision perception for machines. The OpenVINO toolkit also helps to abstract the different types of Intel® hardware accelerators, enabling developers to write once and deploy anywhere the many new AI-driven applications needed to optimize patient care.

Intel security technologies help protect smart hospitals
Securing hardware is foundational to protecting the technology driving smart hospital innovations. At Intel, we are taking a security-centric approach. Intel's multimodal scene intelligence framework leverages multiple hardware-based security capabilities to protect the newly connected clinical data and workflows.

Smart hospitals demand the highest levels of security across all platforms. Intel architecture helps to protect data, defend against cyberattacks, and provide highly available resilient systems that can help keep life-critical capabilities up-and running 24x7.

Learn more

For more information on Intel® SceneScape please visit intel.com/scenescape

For more information on Intel® technologies that are powering the smart hospital, contact health.lifesciences@intel.com.

Dive deeper into how Intel is helping to enable the smart hospital›

Explore the capabilities of Intel Distribution of OpenVINO toolkit›

Learn security measures built into Intel hardware›

Intel security technologies are designed to help protect critical workloads and data with features like:

- Hardware-based acceleration of cryptography operations to help keep data private and IP safe
- Trusted execution environments to help protect applications running as distributed connected edge services
- Platform integrity to provide root of trust protection for firmware, software, and data
- Tamper-resistant storage that prevents sensitive information from being deciphered and cloned

---

Conclusion: Transforming patient care with Intel innovation

The healthcare industry is at an inflection point today, with smart hospitals driving new levels of technological complexity impacting many aspects of patient care. Intel meets the needs of today's fast-advancing healthcare industry with a portfolio of hardware and software technologies built to deliver high performance, intelligence, end-to-end security, and seamless connectivity across the smart hospital infrastructure. Intel drives technology standards with partners to help smart hospitals fully leverage both their existing technological investments and future innovations to come.

Partnering with Intel ensures that smart hospitals have access to the vast range of technologies needed to accelerate the delivery of patient care, operate more intelligently, and power a business model built for a future rich in innovation.

Notices and disclaimers

Intel is committed to respecting human rights and avoiding complicity in human rights abuses. See Intel's Global Human Rights Principles. Intel® products and software are intended only to be used in applications that do not cause or contribute to a violation of an internationally recognized human right.

Performance varies by use, configuration, and other factors. Learn more at intel.com/PerformanceIndex.

Performance results are based on testing as of dates shown in configurations and may not reflect all publicly available updates. See backup for configuration details. No product or component can be absolutely secure.

Your costs and results may vary.

Intel® technologies may require enabled hardware, software, or service activation.

intel.