How you know a hospital is smart

Hyper-connected, intelligent and human-centered, a smart hospital is future-proofed for decades to come.

Smart hospitals combine state-of-the art hospital design with the latest virtual care technology, AI-driven decision support, connected IoT sensors and robotics, all interconnected by digital platforms to fundamentally re-engineer how care is delivered across a health ecosystem. This redefines the way patients consume care — from their smartphones to a smart hospital — and beyond.

In a smart hospital, people, the environment and systems are connected in real time. The vast amounts of data generated through this interconnectivity are used in intelligent ways to improve the quality of core processes of personalized and safe patient care and efficient, high-performance operations.[1] Traditional hospitals that successfully complete the transformation to becoming a smart hospital can radically improve the patient experience, personalize medical treatment, better utilize scarce and expensive resources, and greatly minimize errors.[2]

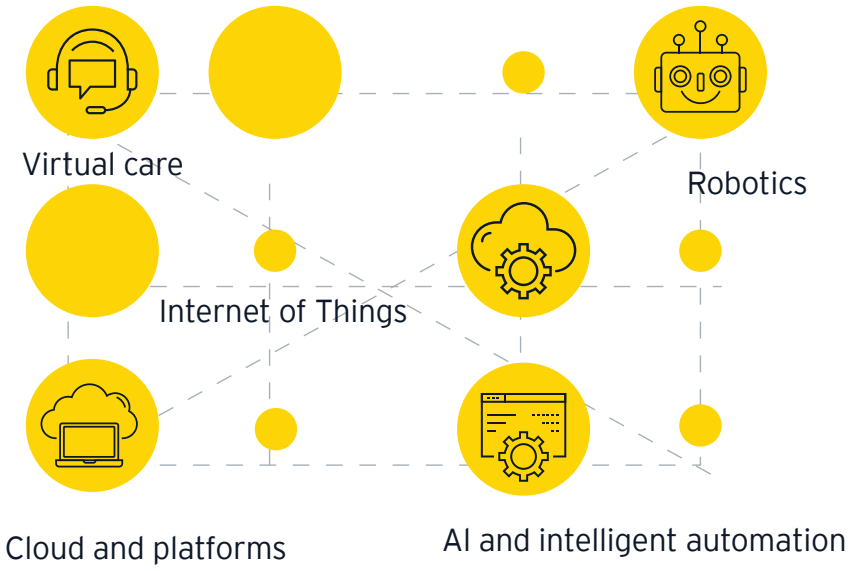
A digital-first future

To realize the full potential of the foundational technologies that define the health industry of the future, namely AI, robotics, intelligent automation, next-generation telecommunications and edge computing, means reimagining the connections between people, processes, and environment. Taking advantage of these new technologies not only improves care delivery outcomes and efficiencies within hospitals, it also makes possible a different role for hospitals in the wider ecosystem. (Figure 1).

The vision of a smart hospital is broadly based. For some, it means investing in technologies that deliver a more targeted set of high-value specialized services within a broader network of partners. For others, pathways extend beyond traditional hospital boundaries into the community and the home. By becoming the anchor or hub in their communities, hospitals can play a critical role in linking and strengthening the health system as it moves to anywhere, anytime care. They can step up as a member of an interconnected, wider ecosystem to help drive health goals around prevention, population health and quality of life outcomes.[3]

Central to the smart health concept is the use of advanced technologies to optimize and automate processes to improve existing procedures and to support new and alternative models of treatment and care.[4, 5] The consumer experience is highly data driven, which gives rise to targeted, personalized, integrated care. At the enterprise level, operational efficiencies come about through process optimization and automation of routine tasks.[6] These include front-, middle- and back-office activities, such as virtual care models, digital-first user experiences, automated supply chain and digital inventory management, and enterprise resource planning.

Figure 1: Features of a smart health service



- Highly personalized, holistic care driven by data
- Smart imaging and early diagnosis through AI
- Home becomes the center of care through vitual care models and IoT technologies
- Platforms provide on-demand access to a shared pool of resources (data, knowledge and staffing) and interconnect the ecosystem
- The right patient, in the right place at the right time through sensor tracking enables seamless patient flow
- Seamless supply chain and inventory management are facilitated by IoT and blockchain

Embarking on the journey to smart

Embarking on the journey to becoming a smart hospital begins with exploring the art of the possible: what kind of experience does the hospital or health system want to provide for patients and employees and in what ways might the journey of care be transformed?

The routes to becoming a smart service are varied. For greenfields or new-build hospital developments, opportunities exist to pursue a new, future-oriented and agile design approach that establishes relevance over the next 20 years and beyond. For existing hospitals, an incremental phased transition to new technologies, redesign of care models, partnerships with others (including providers, community organizations and tech companies), and the automation of many operational activities and processes will be more likely. Irrespective of the path to be followed, to shift with confidence toward a hyper-connected and intelligent smart hospital means making decisions around what to grow or transform in the existing business, scaling actions and investments at the right pace, and driving cultural change across the organization.

Thoughtful patient-centric design

The road map toward becoming smart starts with an interdisciplinary mix of medical, social sciences, design, technology and strategy talents to design and build around patient journeys and the workforce experience.

In a smart health system, the patient experience is the starting point even before the patient enters the physical space or the virtual waiting room. The design intent is to simplify, automate and personalize routine processes to improve patient engagement and provide a better care experience. Guiding visitors to available parking, achieving the efficient movement of patients around a hospital through digital wayfinding, and individuals having opportunities to personalize their environment and care settings, including room ambience and menu selections, all add up to a better patient and caregiver experience and a positive healing environment. From an enterprise perspective, the potential for error is reduced, workflows and administrative processes are streamlined, and clinicians can spend more time caring for patients, away from their computers.

The design focus doesn't end at the walls of the hospital or virtual care user interface. Rather, agile design of smart buildings and virtual services, including modular facilities, hardware, software and networks, is required to meet future demand, as new technologies, innovative new care models and different ways of working come into play.

Smart health systems share five foundational design principles:

Hyper-connected

Physical and virtual environments and a health information architecture built upon data liquidity within and between systems; this includes connecting with other care settings and organizations, such as primary care, specialists and community care workers

Intelligent

Through connected platforms and data, with access to insights that support fast and accurate real-time decisions, both clinical and operational

Human-centered

Patient-, family-, and employee-centric where human-centered service design puts people at the center of problem solving by developing a deep appreciation for their needs, motivations and challenges[7]

High reliability

Combines high-reliability process design with intelligent automation, sensors and predictive analytic, to prevent, predict and minimize the risk of harm, medical errors and substandard care[8]

Sustainable

Models of care that are clinically, financially, economically and environmentally sustainable for hospitals, their workforce, patients and communities

Key assets of smart hospitals

A smarter future where advanced clinical technologies integrate with built infrastructure and sustainable technologies awaits. The transition to a smart, hyper-connected and intelligent hospital will incorporate the following:

1. Patient-centric for a better patient experience

Patients are at the heart of a smart hospital service design. In a broad-based, hyper-connected health ecosystem, physicians, providers, data technicians, pharma companies, biometric systems, medtech professionals and others all work together, leveraging AI and other advanced technologies to provide bespoke care for each and every individual.

2. Technologies that enable fast, flexible and reliable care

Smart hospitals leverage technologies not only to improve care delivery within the hospital itself, but also to connect the hospital to a wider health care delivery ecosystem and drive patient centricity across all care environments. Algorithms embedded in care pathways and operations automate processes, optimize resources, predict conditions, and support clinical decisions to provide the best individualized care for every person. In Canada, for example, Humber River Hospital is extending its digital transformation into a whole of system care coordination focus, coordinating between the hospital and community care providers with hub and spoke command centers.[9]

- **AI and intelligent automation**
  Smarter front- (for example, patient-facing apps), middle- (real-time diagnostics) and back-office (logistics and supply chain) processes will drive better patient experiences, productivity gains and improved outcomes.
- **Virtual care**
  Interactive consultation will be possible between patient and clinician or between clinicians via a range of capabilities (voice, video, or both) and modalities (synchronous or asynchronous) across the continuum of care.
- **IoT and smart sensors**
  These will enable connectivity between different departments within a hospital, as well as to the extended health ecosystem. Wearables and sensors collect and broadcast real-time data about patients to a central organizing platform.
- **Robots, drones and 3-D printing**
  These support new and highly accurate medical procedures, optimize the utilization and deployment of the human workforce, and improve the speed and availability of care and across the supply chain.
- **Digital reality (augmented reality/virtual reality)**
  Immersive experiential learning and workforce training, creation of a virtual world for complex procedures, and effective patient healing will be possible.

3. Interconnected platforms for real-time decision making

Utilizing real-time data, patients can be treated in the right place at the right time. This also allows for rapid, evidence-based decision-making. With shared technical and semantic specifications and standards for data and information exchange, platforms aggregate data from multiple sources (including ecosystem partners) and integrate it with EHRs and other IT systems, making the data valuable.[10] Only 20% of the information relevant to health is available in the health system today.[11] Integrating health system information with new data sources (social, behavioral, financial and environmental) is becoming increasingly important in the pursuit of proactive and participatory care.

4. Partnerships with ecosystem players

Smart health systems proactively seek out new ways of partnering (especially with technology companies) that blend their health care expertise with high-tech skills, connected technologies and deep consumer insights. In so doing, they leverage technologies to take the lead in developing innovations and delivering transformation essential to thrive in the new environment of partnerships, alliances, new locations and consumer orientation.

5. Smart infrastructure

- **Healing environment**
  A built environment is designed to aid patients to recover faster, physically and mentally.[12] Specifically, this refers to architecting physical and digital spaces as supportive environments for health improvement, supporting workforce productivity and efficiency, and reducing workforce stress, and minimizing waste.
- **Digital twin**
  A digital twin refers to the digital replica of the physical assets, people and systems of a hospital. A convergence technology that bridges the gap between the real and virtual, a digital twin is used to monitor, adjust and optimize the functions of physical settings, such as pre-emptive maintenance or demand management prediction. Clinical applications include health status monitoring and continuous feedback to improve well-being and behavioral nudges and support for adherence to treatment programs.[13]
- **Command centers**
  AI-powered command centers, often compared to an air traffic control center, analyze the clinical and location data to monitor supply and demand across the network in real time. Real-time monitoring of patients enables the hospital to identify patients with deteriorating health status, synchronize care delivery, reduce errors, and predict pressure points and bottlenecks in patient flow.[14]
- **Data environment**
  For the platforms to function effectively, smart health systems create an open platform environment to connect and share data, at scale, within and between enterprises and systems. The superior platform will separate content and technology and be vendor neutral, distributed and modular incorporating third-party as well as legacy systems. The EY report "How will you design information architecture to unlock the power of data?" covers in detail the architecture for the right data environment for tomorrow.
- **Hospital at home**
  Portable, user-friendly infrastructure and equipment extend the hospital environment into the patient's home to avoid hospitalization or reduce the length of stay.[15, 16]

Smart hospital is a transformation – not just a tech project

While advanced technology is the key enabler, developing a smart hospital is not just a technology project. Embarking on a smart health journey requires thoughtful consideration of known challenges, strong change management and executive leadership. It involves participation of all stakeholders: management, physicians, nurses, staff and ecosystem partners.

The transformation journey to the smart hospital of the future must occur at the right pace for the organization and deliver the right combination of elements that are wanted and needed. For some, this will mean looking to optimize existing assets (either by modification or extension), introduce resources that complement the existing core, or to create a new ecosystem from the ground up.

The road ahead will be shaped by the answers to the key questions raised earlier in this article – that the key to becoming future-proofed as a smart, interconnected and intelligent hospital and health system rests with the vision of the experience to be provided for patients and employees and the ways in which the journey of care will be transformed.

Top questions for health executives

Executives and health care leaders should ask themselves three questions as they reimagine their smart health transformation:

- Given our current stage along the technology maturity journey what opportunities exist to personalize, simplify, automate, and streamline services to create value now, as well as in the future?
- How can we embark on an inclusive design experience with patients, caregivers, employees and community partners to create the best pathway for success?
- How do we work toward our vision of a smart hospital, while also attending to the business of today? Where do we have opportunities to take costs out of our operations through automation of manual processes and enable the use of the associated data in a smart way?

To get in contact with an EY Smart Health solutions team member, email smarthealth@ey.com. To read further EY Smart Health insights, visit ey.com/exploresmarthealth.

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References

1 Sabyasachi Dash, Sushil Kumar Shakyawar, Mohit Sharma and Sandeep Kaushik, "Big data in healthcare: management, analysis and future prospects," *Journal of Big Data*, 19 June 2019.

2 Roberto Moro Visconti and Donato Morea, "Healthcare digitalization and pay-for-performance incentives in smart hospital project financing," *International Journal of Environmental Research and Public Health*, 30 March 2020.

3 Samantha Artiga and Elizabeth Hinton, "Beyond health care: The role of social determinants in promoting health and health equity," *Kaiser Family Foundation Issue Brief*, 10 May 2018.

4 Igor Ilin, Oksana Iliyaschenko and Alexandra Konradi, "Business model for smart hospital health organization," *SHS Web of Conferences*, 2018.

5 "Smart hospitals: security and resilience for smart health service and infrastructures," *European Union Agency for Network and Information Security (ENISA) website*, November 2016.

6 Peter Campbell and William Scott, "A model-based study of concept development for hospital wayfinding to improve operating efficiency," *Insight*, 2014.

7 Victoria Bates, "'Humanizing' healthcare environments: architecture, art and design in modern hospitals," *Design for Health*, 15 February 2018.

8 Peter J. Pronovost, Sean M. Berenholtz, Christine A. Goeschel, Dale M. Needham, J. Bryan Sexton, David A. Thompson, Lisa H. Lubomski, Jill A. Marsteller, Martin A. Makary and Elizabeth Hunt, "Creating high reliability in health care organizations," *Health Services Research*, 9 June 2006.

9 Conversation with EY, September 2020.

10 Institute of Global Health Innovation, "Harnessing the power of data: can reality catch up with ambition?" *Imperial College London*, 7 May 2020.

11 Laura McGovern, "Health Policy Brief: The Relative Contribution of Multiple Determinants to Health Outcomes," *Health Affairs*, 21 August 2014.

12 Calbert H. Douglas and Mary R. Douglas, "Patient-friendly hospital environments: exploring the patients' perspective," *Health Expectations*, 7 March 2004.

13 Namrata Bagaria, Fedwa Laamarti, Hawazin Faiz Badawi, Amani Albraikan, Roberto Alejandro Martinez Velazquez and Abdulmotaleb El Saddik, "Health 4.0: digital twins for health and well-being," *Connected Health in Smart Cities*, January 2020.

14 Erin M. Kane, James J. Scheulen, Adrian Püttgen, Diego Martinez, Scott Levin, Bree A. Bush, Linda Huffman, Mary Margaret Jacobs, Hetal Rupani and David T. Efron, "Use of Systems Engineering to Design a Hospital Command Center," *The Joint Commission Journal on Quality and Patient Safety*, 10 January 2019.

15 Jared Conley, Colin W. O'Brien, Bruce A Leff, Shari Bolen and Donna Zulman, "Alternative Strategies to Inpatient Hospitalization for Acute Medical Conditions: A Systematic Review," *JAMA Internal Medicine*, 1 November 2016.

16 Alex D. Federman, Tacara Soones, Linda V. DeCherrie, Bruce A. Leff and Albert L. Siu, "Association of a Bundled Hospital-at-Home and 30-Day Postacute Transitional Care Program with Clinical Outcomes and Patient Experiences," *JAMA Internal Medicine*, 1 August 2018.

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