



THE
HOSPITAL
OF THE
FUTURE

Life Sciences & Healthcare Industry



Contents

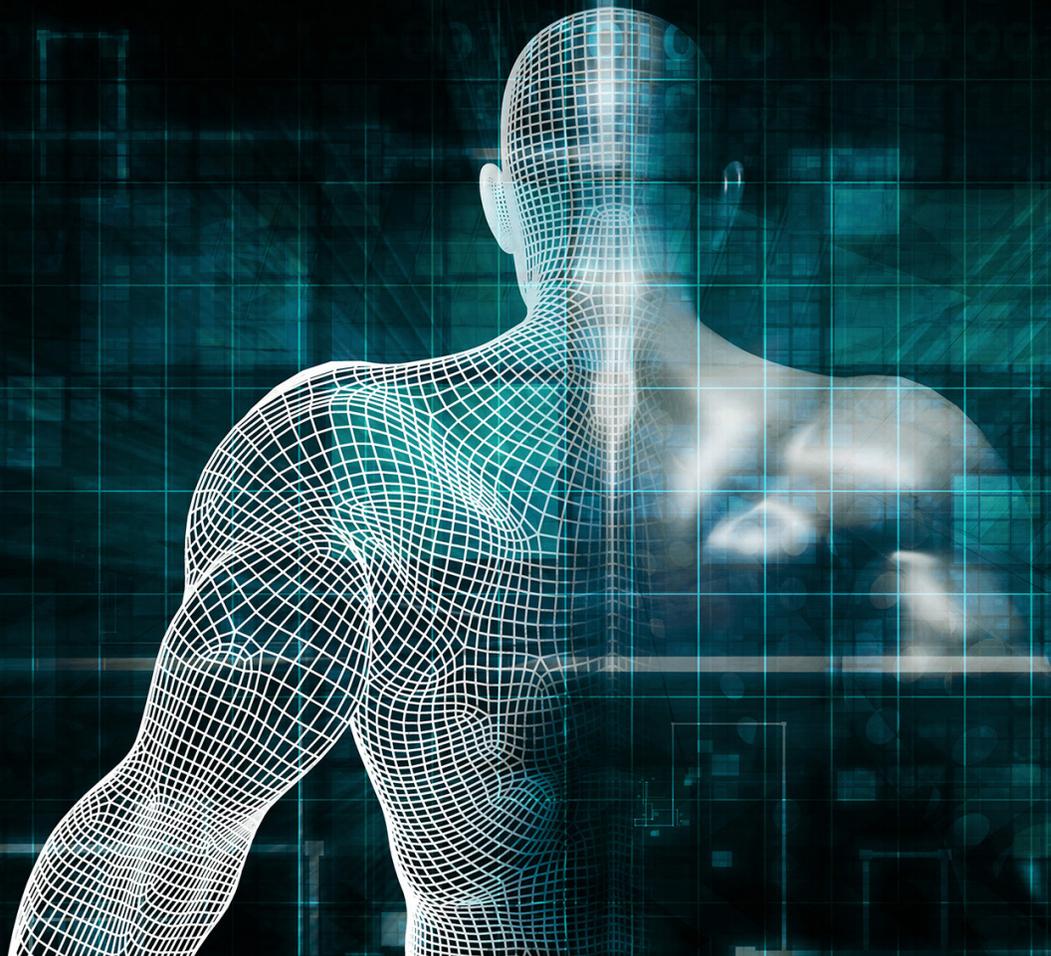
- Introduction: Personalized Healthcare Transforming the Industry3**
- The Driving Forces in Healthcare4**
 - Where is the Healthcare Industry Headed? 4
 - Deploying Tech-Savvy Healthcare Solutions.....5
 - Looking to the Future 6
- The Hospital of the Future7**
 - How Industry Trends are Shaping the Next-Generation Hospital..... 7
 - Physical & Digital Convergence 8
 - Patient Self-Service Enablement..... 10
 - Care Management 13
 - Patient Communication 15
- Measuring Success 16**

Introduction: Personalized Healthcare Transforming the Industry

The transformation of healthcare delivery from volume- to value-based care is driving major changes in the way healthcare and hospital systems operate. With the industry being a significant influencer of world economies, cutting-edge technological advances are needed to meet the high expectations of all stakeholders and adapt to the changing forces in the sector.

To make that vision a reality, new healthcare solutions that leverage data to make better care decisions, create intuitive clinical applications across state-of-the-art facilities, and engage patients through real-time monitoring and accessible, interconnected systems are needed. In order to provide these services, it is imperative that next-generation healthcare systems be secure, scalable, efficient, and valuable. As healthcare continues to move towards a consumer-focused model, the long-term financial trends will have a direct impact on providers, payers, and facilities management.

This whitepaper provides an in-depth analysis of the current state of the industry, identifying emerging trends and potential challenges related to healthcare and technology. It also offers a vision and strategy for creating a hospital experience that drives optimal patient outcomes, enables more comfortable recovery, and provides healthcare professionals with insights to efficiently deliver personalized care. This is the hospital of the future.



The Driving Forces in Healthcare

WHERE IS THE HEALTHCARE INDUSTRY HEADED?

The introduction of value-based programs and quality incentives from the US Centers of Medicare and Medicaid Services, along with political changes, are accelerating the deviation from volume-based care. Providers are reporting shrinking margins as private payers gravitate towards value-based programs. The launch of the Hospital Readmissions Reduction Program (HRRP) has resulted in decreased readmission rates across the country, as hospitals try to avoid the penalty of lower Medicare reimbursement rates. This shift towards value-based incentives, such as the upsurge of Accountable Care Organizations (ACOs) and Relationship-Based Care, creates a greater focus on outcomes for patients. Healthcare systems need to view patient health longitudinally by monitoring patient behavior and managing expectations across a longer continuum of care. Evidence-based care can be seen as a path to decrease the cost of healthcare by lowering the number of services required to diagnose a patient. To apply evidence-based care practices, physicians will need to leverage information sharing in order to have a better picture of patient health.

Patients expect personalized, real-time access to their health services and providers through their personal connected devices such as mobile apps and wearables. Approximately **88% of consumers** are willing to share their personal data to improve their own health and find new treatments.¹ For these data-sharing digital apps to be successful, they must be able to provide access to a patient's medical history quickly and seamlessly. Demand will grow as patients are incentivized to use devices to manage their health and share critical information with family members. For example, this year Aetna will begin distributing and subsidizing Apple watches to employers, members, and its **50,000 employees**.

Mobile is not only appealing to the patient, but to clinicians as well. While only **21% of consumers** have used a mobile device to refill a prescription, **60% are willing to have a video visit** with a physician through a mobile device.² Similarly, **58% of physicians** would rather provide a portion of care virtually and **81% say** mobile access to medical information helps coordinate patient care. As this research shows, the adoption of mobile and healthcare IoT is no longer a barrier to entry.

¹ HRI Consumer Survey, PwC, 2015 and HRI Clinician Workforce Survey, PwC, 2014 and 2015

² HRI Consumer Survey, PwC, 2015 and HRI Clinician Workforce Survey, PwC, 2014 and 2015

DEPLOYING TECH-SAVVY HEALTHCARE SOLUTIONS

Although EHR systems are standard today, six years ago only 16% of non-federal acute care hospitals used them.¹ Now, the challenge is exchanging data between EHR systems and analyzing it effectively, as only 40% of hospitals have patient information electronically available from care settings outside of their organizations.² Furthermore, as larger hospitals begin transitioning to smaller and more distributed facilities, there is an increasing need for integrated information sharing between facilities, patients, and physicians. The shift from legacy systems to more modern and effective solutions, such as healthcare distributed ledgers, blockchain, customer engagement hubs, real-time hospital and cloud-based solutions, is necessary to keep pace with value-based and patient-first care trends.

As next-generation healthcare systems start encouraging patients to bring their own devices into the hospital room, both care teams and patients will benefit. Clinicians will be armed with better knowledge through IoT-enabled apps and trackers, and patients can enjoy the comforts of home through on-demand entertainment and customizable room layouts. Integrated data will give clinicians the ability to anticipate patient needs so that care can be administered proactively. Effective data management not only impacts the patient and physician within the walls of the hospital, but eases the transition to a patient's home and automates room turnover.

To see these benefits of big data come to life, most technology experts would recommend a cloud-based solution for easy data integration, flexibility, and anytime, anywhere connectivity. In comparison to other sectors, the healthcare industry has been slow to take advantage of the cloud due to security and compliance concerns. The demand for a HIPAA-compliant cloud environment is certainly increasing, as **53% of healthcare employees** already use three or more devices for work.³ In the last year, cloud-based solutions have been regarded more positively than before. As cloud adoption increases among data-sensitive government agencies and highly-regulated businesses, one way to address security challenges is a hybrid cloud to keep the most sensitive data on premises. While security is clearly a concern, the business benefits of using cloud technologies far outweigh the disadvantages.

¹ <http://dashboard.healthit.gov/quickstats/pages/FIG-Hospital-EHR-Adoption.php>

² https://www.healthit.gov/sites/default/files/briefs/onc_databrief25_interoperabilityv16final_081115.pdf

³ <http://www.forbes.com/sites/danmunro/2014/09/01/over-90-of-cloud-services-used-in-healthcare-pose-medium-to-high-security-risk/#514f14564ca4>

LOOKING TO THE FUTURE

In Spring 2016, EPAM conducted independent research with nearly two dozen physicians and patients. According to the findings, physicians cited that they have limited time with each patient, struggle to explain complicated medical procedures, and would appreciate better insight into how a patient is feeling. Participating nurses said they have difficulty determining whether a call alert is critical, communicating with other clinical staff, and prioritizing requests from patients. From the patient perspective, participants stated that they were scared when being admitted into the hospital, missed home frequently, and when released, found discharge information unclear.

While the industry certainly faces challenges, the implications for the future of healthcare are vast and exciting. With the speed at which technology is moving, the next-generation hospital and physician’s office has become a reality. It took 10 years to map the first human genome and now an ultra-fast sequencing machine can do it in three days.¹ By 2020, medical data will double every 73 days² and connected IoT will triple by 2021 through the use of wearables, smartphone accessibility, and augmented and virtual reality.³

With these advancements, physicians have the opportunity to gain tremendous insights into their patients’ health and history. As data and services become hardware-agnostic, there’s an even stronger case for finding a compliant, cloud-based solution for the patient, provider, payer, and facilities management. The healthcare industry is in the midst of a transformation – where the trends of value-based and patient-first care have made their way directly into the hospital room, onto the operating table, and even into a patient’s home upon discharge.



“Technology is most powerful when it supports human interaction to improve care.”

- PHYSICIAN



“I need to stay connected with my patients, so I can be there when they need me most.”

- NURSE



“In a new hospital, managing more and more connected devices will be a challenge.”

- FACILITIES ENGINEER



“I want to feel that I’m informed, receiving the best care, and recovering comfortably.”

- PATIENT

¹ http://www.stltoday.com/lifestyles/health-med-fit/medical/new-technology-at-wash-u-maps-human-genome-in-days/article_9ed22975-a385-5b53-897a-ff88cba2442b.html

² <http://www.healthcare.uiowa.edu/2020/>

³ <https://www.juniperresearch.com/press/press-releases/%E2%80%98internet-of-things%E2%80%99-connected-devices-to-triple-b>

The Hospital of the Future

HOW INDUSTRY TRENDS ARE SHAPING THE NEXT-GENERATION HOSPITAL

After evaluating industry and technology trends, healthcare systems need to deploy models that create experiences centered on the patient and provide professionals with insights to efficiently deliver more personalized care. The following goals will help guide the vision for the hospital of the future:

- Make patient experience and outcomes the focus of care.
- Leverage a connected room to influence successful outcomes.
- Focus on recovery before and after discharge to decrease readmissions.
- Optimize the facility to continuously drive down operating costs while improving the experience.

While the next-generation hospital should first and foremost concentrate on the patient, it's important that solutions also consider the impact on providers, payers, facilities management, and family members. To keep up with the trends of anytime, anywhere connectivity and data integration, patients and their families need to be equipped with the digital tools they need to take control of their health. Likewise, physicians and doctors need to be connected with their patients to truly deliver the best care, and facilities staff need to have solutions available to automate operations.

There are four areas where enabling technologies will play a crucial part in designing the next-generation hospital: physical and digital convergence, patient self-service enablement, care management, and patient communication. The next section will explore how these technologies will shape what the hospital of the future may look like.

PHYSICAL & DIGITAL CONVERGENCE

When patients are admitted, their first impression of their care starts with the emergency or waiting room. Next-generation hospitals will start investing in redesigned ER and admissions areas to improve cognitive well-being from the initial point of patient interaction. Adaptable physical space throughout the hospital, from the ER to the operating room to the patient room, makes each patient feel like they are receiving personalized and attentive care. Configurable space also allows for real-time adjustments, such as disaster response, flu outbreak, or a winter storm emergency. As hospital systems integrate and analyze data for effective patient outcomes, changes in the hospital room or equipment may be prescribed for certain conditions.

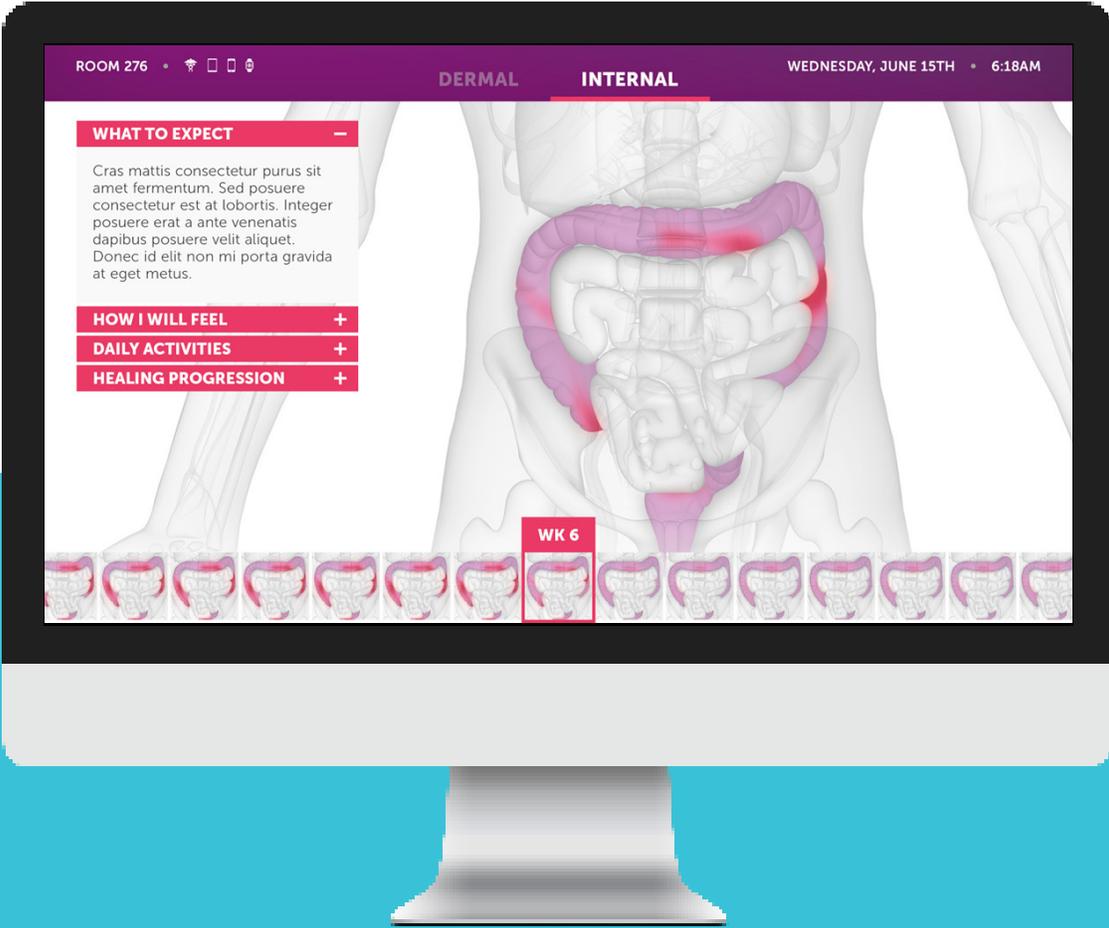
One key theme for the hospital of the future is continuous patient monitoring throughout the treatment process. The single question every patient answers over and over again throughout their hospital stay is “How are you feeling?” and as seen through EPAM’s experience, physicians still struggle with truly understanding how a patient feels. Through the use of IR imaging, care teams can evaluate body temperature and analyze physiological activities to more accurately identify a patient’s health status. Additionally, smart regulation provides real-time, always-on dashboards that inform the patient about their medication, appointments, care instructions, and even give background information for the care team on duty.



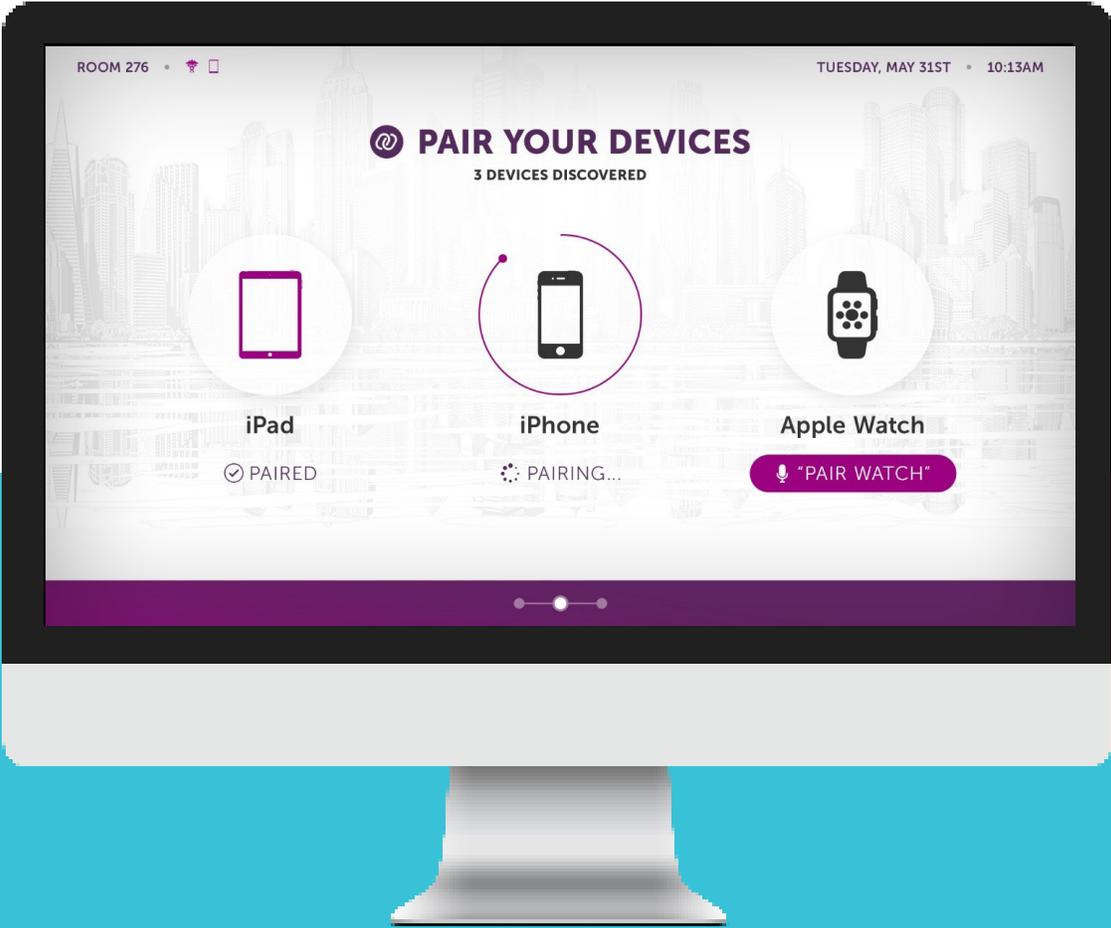
Room temperature, light, noise, and other environmental conditions may impact patient outcomes. Generally, patients suffer from poor sleep in hospital environments and sleep throughout the day. Improving sleep quality has a direct impact on patient health. By gathering information from past patients with similar diagnoses and monitoring the sleep patterns and outcomes of the current patient, systems can automatically adjust to fit the patient's routine based on recommendations gleaned from big data. Similar technologies can also be used for facilities management staff to monitor inventory. By connecting systems to alert operations if certain supplies need replenishing either in a patient room, nurses station, or operating room, inventory can be managed on the back-end for realized cost savings.

PATIENT SELF-SERVICE ENABLEMENT

With industry trends showing that more consumers are invested in their health, technologies in and out of the hospital will enable patients to take control of their diagnosis, treatment plan, and overall recovery. Physicians will implement “open charts” for their patients, allowing for increased communication and transparency. Apps and integrated data systems will allow patients to submit admissions paperwork through a mobile device to reduce the time spent in the waiting room and filling out redundant hospital forms. Doctors will have real-time access to this patient information wherever they are located. Video or audio recordings of patient-doctor conversations will allow patients to revisit complex medical discussions and advice, as the majority of patients struggle with understanding in-depth medical terminology. Additionally, these recordings will create an archive for care teams to reference at any point throughout the patient’s lifetime and will help doctors and nurses remember patient-specific concerns and pain points. Furthermore, the use of augmented and virtual reality will allow doctors and surgeons to educate patients about their condition, procedures, and the recovery process through 3D-rendered experiences, giving patients and their families a visual representation of their health.



Allowing patients to feel in control of their health extends beyond patient-physician interaction. The majority of a patient’s time in a hospital is spent in his or her room, so leveraging personalized technologies is crucial for the patient to feel engaged in their recovery. As technology becomes even smarter in supporting natural human behavior, patients will be able to change preferences in their rooms with voice, touch, or gestures with their own devices. This idea of “BYOD” (Bring Your Own Device) doesn’t require patients to learn a new system, as they already feel comfortable with their own tablet or smartphone and likely will use it anyway. Patients will be able to use their own devices to set room controls, browse on-demand entertainment, or even select meal preferences. Patients can also share progress and updates with family, loved ones, and friends through applications that enable mass notifications. Through the use of wearables, patients will have access to their EHRs and providers will be able to easily monitor the patient’s health. These technologies are not intended to replace the human aspect of care, but to reduce complications and more quickly recognize when an in-person visit or hospitalization is necessary.



Investing in legacy system migration to cloud-based data solutions will allow hospitals to implement outcome-based recommendations for patients, such as food and entertainment choices. Based on past patient data, patients will be able to view recommendations from books to magazines to movies throughout their hospital stay and build a sense of connectedness with past patients via video testimonials and social networks.

Patients often have questions about their health, medication, or prognosis throughout their stay. After talking with family members or nurses or just taking time to digest complicated medical information, patients may need their care-related questions answered outside of their regular check-ins with the physician. Patients may utilize the call button in their hospital room when they have questions, but as seen through EPAM's experience, it's difficult for nurses to determine (and therefore, prioritize) whether a patient's call is a true emergency or simply a question. Through the use of clinical chatbots, patients can use voice-integrated virtual assistants (similar to Siri) through their own devices to answer questions in real-time, provide support, or set medication reminders. This conversational interface enables direct and immediate communication with the care team, allowing the patient to feel at ease and in control of their health.

CARE MANAGEMENT

As the entire healthcare system moves towards a patient-first approach, effective data management is crucial to enabling physicians to generate insights from population health data, past patient data, and family history information to provide the best care. Data gleaned from genetic sequencing, EHRs, and IoT-enabled devices will allow doctors to detect and treat conditions more quickly and accurately. Edible digital pills will allow physicians to track patients from the inside to determine the effectiveness of the medication and overall health of the patient. Next-generation hospitals will enable data-driven decisioning to automate the patient's 5Rs (right doctor, right medication, right time for medication, right dosage, and right delivery).

The easier it is for the patient to monitor their own health, the more likely it is that the patient will make a full recovery. Leveraging connected pill bottles and mobile apps make it easier for the patient to remember to take their medication or perform exercises as part of their treatment plan. Next-generation hospitals will utilize gaming incentives for patients to improve medication adherence or cooperate with the care team. These technologies can be used in and out of the hospital upon discharge.

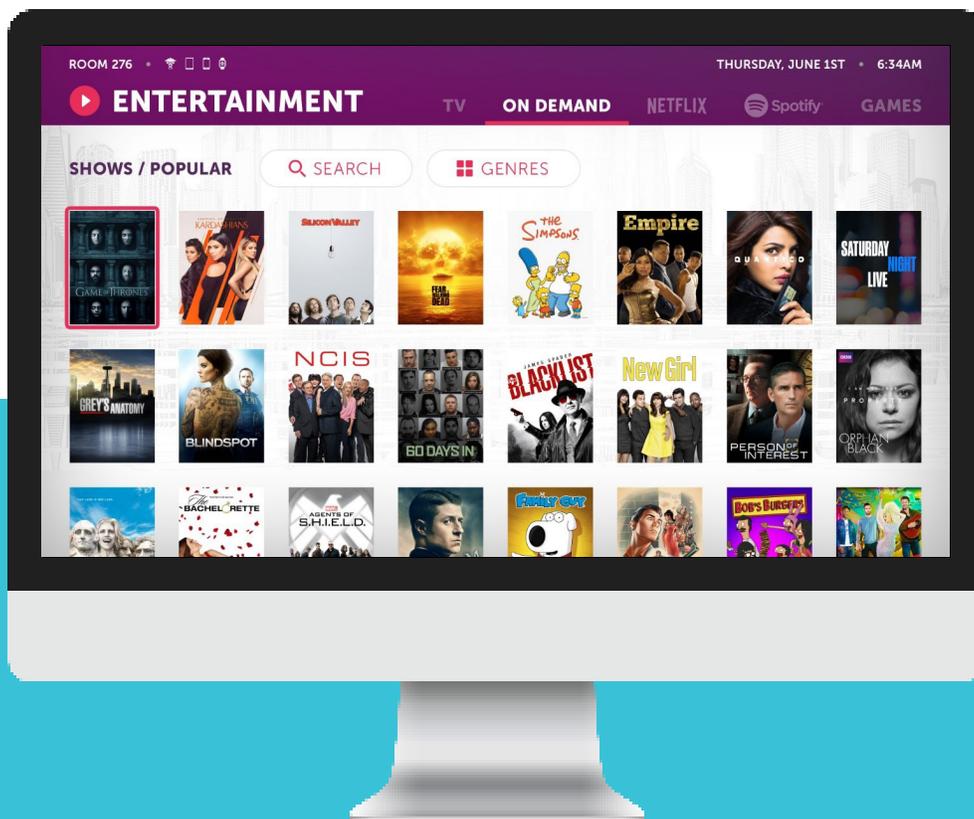


Care management certainly doesn't start and end in the hospital. Arguably, the most important part of recovery is when the patient is discharged and needs follow-up care at home. The most successful cases of recovery occur when the patient receives continuous personalized care. In the past, when a patient was discharged, they may have received a follow-up phone call from the physician or nurse. Through telehealth and IoT, patients will have direct access to interact with specialists virtually through video or text. Further, physicians and nurses can track the patient's recovery status and outcomes through trackers, such as wearables or smartphones, to collect data, such as vital signs or medication adherence. When patients need to follow up with another specialist, such as a physical therapist, an up-to-date medical file will increase the value of the specialist visit and therefore, the chances of a full recovery. The use of video and digital notes, as well as tracking a patient's care team with real-time updates, progress, and recovery information, makes case handoff more likely to be successful.

PATIENT COMMUNICATION

Ensuring patients are equipped with all of the information that they need to feel in control of their health requires systems that enhance patient-physician communication. The hospital of the future will employ digital patient journals that are shared directly with the hospital and medical staff to gain a better understanding of how the patient is feeling. The journal will also regularly monitor keywords to track patient data and compare it to past patient information with similar cases. As infotainment systems become increasingly popular, patients might prefer this alternative to BYOD. By integrating patient health information with entertainment options, such as books, TV, or games, patients have the ability to stay up-to-date with their care teams and schedule for the day. These systems will increasingly include indoor geolocation technology, such as beacons or RFID, to enable patient and physician tracking.

Making a patient feel at ease and comfortable in the hospital impacts the results of the patient's outcomes. Next-generation hospitals will deploy real-time translation solutions to aid non-English-speaking patients or their families. Managing the expectations of family and friends and educating them about the progress of their loved ones is crucial to maintaining a patient-first approach. Hospitals will place more emphasis on providing coping techniques and support groups for family members to aid them in this overwhelming and emotional process.



MEASURING SUCCESS

It's clear that the next-generation hospital fits well within the context of the trends that are shaping the transformation of healthcare delivery. To analyze its success, there are six considerations to measure:

- Improved patient outcomes
- Improved patient satisfaction
- Reduced patient readmissions
- Reduced lifecycle cost
- Reduced first cost
- Improved clinician experience

Chronic disease represents 86% of total US healthcare costs.¹ By implementing a continuum of care and more effective data integration, physicians have a greater chance of being proactive in addressing chronic disease, resulting in reduced first costs and lifecycle costs.

Consumers and physicians are already demanding more personalized approaches to care that can be monitored virtually and digitally. With better entertainment and meal options, direct access to their care teams, and continuous personalized care upon discharge, patients have a greater chance of making a full recovery, improving satisfaction and outcomes.

The healthcare industry has reached a turning point. Hospitals need to invest in legacy system migration, generate insights from big data to improve operating costs and influence care, and focus on a personalized patient experience beginning with the initial emergency call and ending with full recovery at home. To remain competitive and disruptive in the market, healthcare systems need an innovative product development and technology integration partner to help them navigate the waves of technology change and build solutions to achieve true digital transformation.

¹ <https://www.cdc.gov/chronicdisease/>



ABOUT EPAM SYSTEMS

Since 1993, EPAM Systems, Inc. (NYSE: EPAM), has leveraged its core engineering expertise to become a leading global product development and digital platform engineering services company. Through its ‘Engineering DNA’ and innovative strategy, consulting, and design capabilities, EPAM works in collaboration with its customers to deliver innovative solutions that turn complex business challenges into real business opportunities. EPAM’s global teams serve customers in over 25 countries across North America, Europe, Asia and Australia. EPAM is a recognized market leader among independent research agencies and was ranked #8 in [FORBES 25 Fastest Growing Public Tech Companies](#), as a top information technology services company on [FORTUNE’S 100 Fastest Growing Companies](#), and as a top [UK Digital Design & Build Agency](#). Learn more at www.epam.com and follow us on Twitter [@EPAMSYSTEMS](#) and [LinkedIn](#).

GLOBAL

41 University Drive, Suite 202
Newtown, PA 18940, USA

P: +1-267-759-9000
F: +1-267-759-8989

EUROPE

Corvin Offices I. Futó street 47-53
Budapest, H-1082, Hungary

P: +36-1-327-7400
F: +36-1-577-2384

CIS

9th Radialnaya Street, Building 2
Moscow, 115404, Russia

P: +7-495-730-6360
F: +7-495-730-6361