

Emerging Technologies Promise to Both Transform and Challenge Healthcare Organizations

Perspectives from healthcare CIOs and IT security leaders about how 5G, IoMT, and AI will move healthcare closer to a patient-first, cost-effective model



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EXECUTIVE INSIGHTS: [HEALTHCARE](#)



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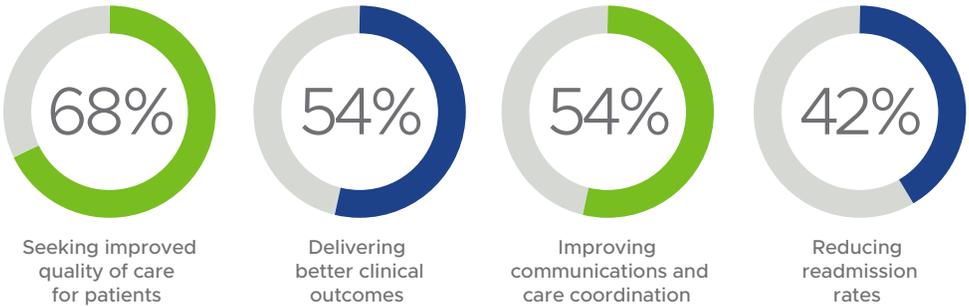
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Executive Summary

In the face of expanding demand for services, today’s healthcare organizations are embracing digital transformation to accelerate patient health, business, and financial goals.

One thing is clear: Patients want greater personalization in their care. They are looking for the same easy, remote, and intuitive access to healthcare that they get from their shopping and banking experiences. This “consumerization” of healthcare is driving hospitals, clinics, and physician practices to find ways to use technology to build processes and procedures around patient needs rather than traditional healthcare delivery methods.

But which technologies should healthcare leaders invest in first? This guide for healthcare executives examines three emerging technologies—5G, Internet of Medical Things (IoMT), and artificial intelligence (AI)—and how each can improve patient outcomes while driving business innovation that includes running more efficient operations. This overview also identifies potential pitfalls and how to avoid them.



SOURCE: *HIMSS Media*

Figure 1: Why healthcare providers are digitally transforming



Innovation Brings Patient-First Into Focus

Although global spending on healthcare is predicted to rise significantly (by a 5.4 percent annual increase to \$10,059 trillion in 2022), healthcare providers anticipate boosting their technology budgets by nearly twice as much—by at least 10 percent this year alone, according to the [2019 Global Health Care Outlook from Deloitte](#). Emerging technologies—5G, IoMT, and AI with machine learning (ML)—open opportunities for innovation bringing a patient-first approach into focus.



COMPARING 5G TO 4G

Network speeds 10x+ faster—up to 20 Gbps versus less than 1 Mbps for 4G

Lightning-fast latency—1-to-2-milliseconds versus 50 milliseconds for 4G

How 5G will change the healthcare landscape

The widely anticipated 5G (also known as *fifth-generation cellular network technology*) will eventually replace 4G LTE, bringing with it greater speed to move more data faster, lower latency for improved responsiveness, and higher bandwidth to connect many more devices at once.

Globally, *more than 20 service providers have announced plans* to offer 5G in 2019. But businesses including healthcare are being told to temper their expectations, as industry observers predict that the U.S. network infrastructure capable of supporting wholesale migration to 5G won't be ready until 2020—or even later. That makes now the perfect time for healthcare organizations to begin planning for all the ways 5G will super-charge their networks.

5G opportunities

5G will enable better care to be delivered faster and at less cost, a benefit to both patients and providers.



Telehealth will expand and flourish.



Quality of care will improve.



All the rich healthcare data generated and captured can be fully leveraged.

Telehealth will expand and flourish. With 5G, healthcare will finally come to patients—no matter where they happen to be. Both patients and doctors are eager for the easier access to healthcare that 5G will enable. *More than 70 percent of healthcare providers* already offer some form of telehealth services, and many are releasing personalized mobile apps for patients to track their health, communicate with clinicians, get test results, and make appointments. 5G will accelerate the speed, adoption, and usefulness of these services as well as advance innovation in ways not yet fully imagined. It will also make it possible for providers to better serve elderly, chronically ill, and remote rural populations. *According to AARP*, 87 percent of adults age 65+ want to stay in their homes as they get older. 5G will make this and more possible by monitoring patients' vital signs—and sending data directly to their doctors. Patients with chronic conditions can get continuous care at home without having to



Mercy Virtual

MERCY BUILDS WORLD'S FIRST TELEHEALTH CENTER

Mercy is an integrated healthcare organization with 43 hospitals and more than 700 physician practices and outpatient facilities, serving more than 3 million patients a year.

CHALLENGE

For almost 200 years, Mercy caregivers have delivered care to the people who need it, and Mercy is always seeking ways to do this more effectively. Intrigued by the possibilities telehealth offers, Mercy dove into researching this new way of delivering healthcare.

SOLUTION

In 2015, Mercy opened the world's first Virtual Care Center, a virtual hospital without beds—or patients—onsite. It serves as a nationally recognized center for developing and delivering telehealth.

BENEFITS

Every day, Mercy caregivers collaborate with bedside clinicians, primary providers, and specialists to analyze patient data in real time, and to diagnose and intervene earlier in illnesses. Supplementing the work of onsite caregivers, the Virtual Care Center provides skillful monitoring and management of chronic diseases, reducing the need for physical doctor visits or hospitalizations.

make constant visits to physical medical locations. And thanks to 5G, rural hospitals can get real-time access to skilled, specialized medical personnel and other resources via videoconferencing and mobile apps.

Quality of care will improve. A 5G network can quickly move huge data files of medical imagery to where they are needed, improving both access to and quality of care. 5G will help doctors see trends in chronic conditions that were difficult to track previously. Rather than waiting for delivery of a patient's historic MRI or CAT scans, such files can be accessible from the cloud within milliseconds to review and compare to a current scan—which will also be available for review hours, if not days, sooner than under 4G. Home monitoring of patients with chronic conditions will become the norm, with alerts sent in real time if clinical thresholds are exceeded. And 5G's low latency and capability to offer enhanced image definition will allow clinicians to make vital decisions quickly with the most accurate information available, leading to early intervention and treatment of medical conditions.

All the rich healthcare data generated and captured can be fully leveraged. Virtually unimaginable volumes of healthcare data now exist—and more are generated every second, thanks to the Internet of Medical Things (more on IoMT in the next section). But providers haven't yet been able to fully make use of it due to network speed and bandwidth limitations. 5G promises to deliver on the promise of data. Take just the data produced by the *70 million* people in the United States who currently use wearable health-monitoring devices. These devices can send data directly to doctors in real time—something that 88 percent of physicians would like. And wearables are expected to cut hospital costs 16 percent by 2022. But getting this data from the “edge” of the network into healthcare providers' hands has been stymied by network limitations. 5G will change all that—accelerating data sharing and speeding analysis.

5G pitfalls

Despite all the good things 5G promises, there will be some bumps in the road. 5G technology isn't yet ready for prime time, so legacy healthcare IT infrastructure must be quickly transitioned to a flexible digital foundation—cloud-ready now and future-proofed for when 5G is here. A recent *Accenture survey* revealed deep uncertainty about 5G. More than 50 percent of respondents said they don't expect the technology will enable them to do much more than they already do. Almost 75 percent said they need help visualizing how to apply 5G to actual business scenarios. Those having difficulty imagining their 5G future should team with a trusted digital transformation provider to plan for how to realize the possibilities of 5G.

Moreover, policy and regulatory requirements are in flux. States are in the process of changing their licensing rules, but on a state-by-state basis. This raises questions. Can a doctor licensed in Oregon treat patients in Georgia through videoconferencing enabled by 5G? How will 5G impact expanded payments by Medicare and the U.S. Department of Veterans Affairs (VA) medical system for telehealth services? Uncertainty makes it all the more necessary for healthcare organizations to accelerate their digital transformation journeys, ensuring they have the most flexible digital foundation to support any app, any cloud, and any device when 5G rolls out and becomes standard.



How IoMT will accelerate healthcare innovation

In the same way IoT—a collection of sensors, devices, and detectors that are interconnected on a network and accessible to and from the Internet—is becoming vital to industries such as manufacturing and retail, IoMT is transforming healthcare operations. Data from “medical things” such as detectors on diagnostic devices or implants in patients’ bodies can be sent to centralized databases for healthcare professionals to analyze in real time. With IoMT, healthcare providers can also collect data from wearables and broad—even global—networks of interconnected medical devices and equipment. This will enable tremendous operational and cost efficiencies and increase the speed and accuracy of patient care delivery. Key for healthcare organizations being able to take advantage of IoMT is possessing a foundational, software-defined model of IT that is capable of standardizing, securing, and scaling dynamic edge and IoMT environments.

IoMT opportunities

In the coming decade, IoMT will be a major catalyst of change for healthcare organizations.



Better quality of care



Significant operational cost savings



Protection of revenues under new payment rules

Better quality of care. Wearables, once a fad at the gym, are now real-time clinical monitors. People depend on them for their health, and caregivers will increasingly use them to remotely monitor post-op patients or those with serious chronic conditions like diabetes. Because IoMT networks can connect to and track virtually any medical device inserted into a human body today, IoMT sensors will go from speeding medical aid to critical patients just in time, to preventing heart attacks, seizures, and strokes, to initiatives yet unimagined.



SIZA ENABLES "SMART HOME" CARE

In the Netherlands, *Siza* thinks in possibilities. It provides support so that people with disabilities can organize their lives better.

CHALLENGE

Siza helps 3,500+ people with physical, mental or multiple disabilities, non-congenital brain injuries, or autism-related impairments. It makes significant investments in technological resources that help disabled people lead more independent lives.

SOLUTION

A client who uses a wheelchair and heavily depends on their breathing equipment must always stay close to a medical facility in case things go wrong with their equipment or physical condition. If problems occur, the nursing staff must be able to respond quickly. With IoT-based monitoring and alerting capabilities, Siza can observe the patient's medical condition from home with wearable sensors and monitor their supporting equipment using AI and also ML to predict whether their respirator is still going to work or not.

BENEFITS

Siza can predict in advance if the patient might need help and then proactively send a nurse to their current location. This enables the patient to move around more freely and live more independently.

Significant operational cost savings. In general, IoMT devices—after initial implementations—run autonomously. Because they are programmed to operate within a specific workflow and to send and receive data automatically, they cost less to manage while boosting the productivity of clinical staff members who otherwise would be manually monitoring patients or extracting information from them during in-person visits. With remote monitoring, patients will make fewer appointments at physical healthcare facilities while being diagnosed and treated more accurately and swiftly, thus avoiding costly complications. This is due to IoMT devices' continuous connectivity. The steady stream of data being analyzed makes it possible to identify patients' health issues in real time that might otherwise take months of intermittent—and very expensive—visits to the emergency room or urgent care clinic to pinpoint.

Protection of revenues under new payment rules. Fee-for-service payment structures also change in the IoMT world. Patients given new hips, for example, who need to be readmitted to hospitals for complications do so at hefty costs to healthcare organizations because of new defined payment rules that don't allow providers to charge more for additional services. IoMT is a digital tool in healthcare organizations' tool belts to prevent these types of revenue losses. With IoMT, healthcare organizations can monitor and check in on patients remotely, identify ones that are at risk, and find solutions to manage their care in ways that drive the best outcomes at the lowest cost. Patients stay healthier—and away from hospitals—while healthcare organizations earn greater fees.

IoMT pitfalls

IoMT has the potential for driving lower costs overall as well as transforming how care is delivered—even pushing the edge of the network all the way out to rural communities that lack services. Because IoMT is new, however, not all medical connectivity and security risks have been uncovered. Take interconnectivity issues. If a device can't communicate properly with other devices or systems, the results could be serious. Thorough IoMT device testing is critical for ensuring that each device interoperates with others with which it must share data. Yet, IoMT innovators targeting healthcare providers often lack full comprehension of the entire complex ecosystem when designing their devices.

Healthcare organizations also must understand and address outstanding security and privacy concerns. International health administrations are in the process of issuing guidelines that must be strictly followed by medical establishments integrating IoMT into their workflows, and these are likely to keep evolving and changing in the coming years. The point of IoMT is that everything is connected. Strategic IT plans that include IoMT must consider individuals' concerns about devices tracking their movements or bodily functions and reporting back to a centralized database. These same plans must also outline how organizations will reduce their attack surfaces as they extend to the edge because a cybercriminal now can have thousands of ways "in" to a network, potentially making individual patients vulnerable. A digital foundation with intrinsic security can help prevent IoMT devices from becoming compromised, strengthening healthcare cybersecurity and privacy postures.



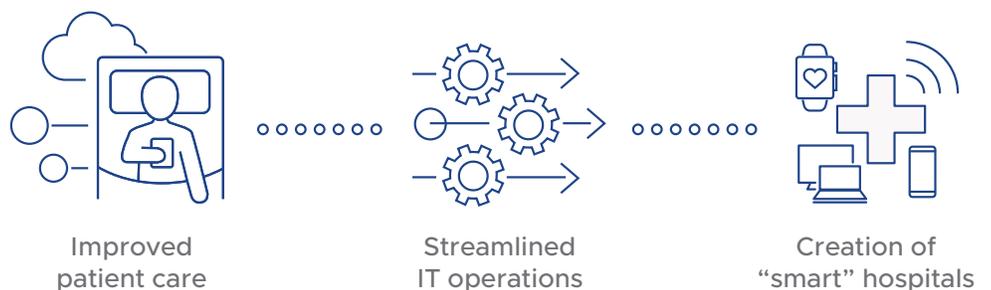
How AI will revolutionize healthcare and healthcare organizations

The potential of AI in healthcare is finally becoming reality. Over the past few years, healthcare providers have invested heavily in AI—and in a subset of AI, ML—to reduce costs while improving patient outcomes. Spending on healthcare AI technology is expected to surpass \$34 billion by 2025, compared to just \$2.1 billion in 2018, [according to market intelligence firm Tractica](#).

AI enables machines to think like humans while ML applies AI techniques to help machines automatically learn and improve from their “experiences”—from processing data—without being explicitly programmed. This is a boon to healthcare organizations that continuously collect and process data.

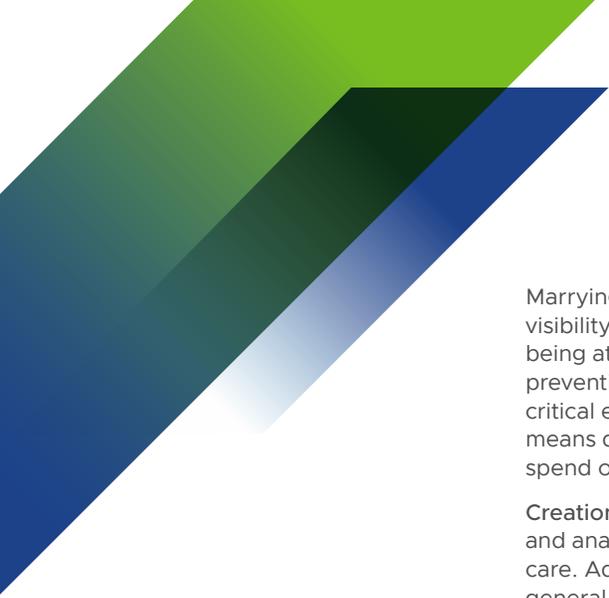
AI and ML opportunities

Healthcare organizations are just beginning to tap into the vast reservoir of possible ways AI and ML can benefit patient care and providers’ businesses.



Improved patient care. AI and ML finally allow healthcare leaders to fully mine all the data they collect to improve patient outcomes—for example, to predict the likelihood of a patient suffering a heart attack or a stroke. In some cases, the AI systems’ diagnostic capabilities are [already outperforming doctors](#). In others, [they’re not](#). But the technology is developing rapidly, with innovations being announced all the time that could be keys to solving different types of cancer, reasons for memory loss, or other world-challenging healthcare conditions.

Streamlined IT operations. Many healthcare providers rely on large, complex, legacy applications to run their businesses. The health and availability of their systems is critical.



Marrying AI and ML with technologies such as cloud, virtualization, and sensors provides visibility into care and business systems—including the increasing number of IoMT devices being attached to the network—plus the ability to monitor everything in real time and do preventive maintenance or otherwise fix performance issues. This ensures availability of critical electronic health record (EHR) resources to clinical and administrative staff. It also means dramatically reduced operating costs with more free time for IT professionals to spend on innovation rather than simply keeping servers up and the lights on.

Creation of “smart” hospitals. Together with IoMT, AI and ML can boost real-time tracking and analysis, resulting in significant improvements to healthcare operations and patient care. Administrative activities—including patient appointment scheduling, billing, and general operations—represent an easy, first-step opportunity for applying AI and ML in healthcare. The goal: eliminating patients’ long waits on hold when telephoning for an appointment, cumbersome billing paperwork, and frustration with repetitive manual processes required by administrators, clinical, and operations staff alike. AI and ML can be used to optimize hospital bed usage, schedule the surgical suite to achieve full utilization, ensure HVAC and security systems are operating at peak efficiency, or otherwise identify bottlenecks to be eliminated in a healthcare organization’s daily routine and operations, among other tasks.

AI and ML challenges

Healthcare AI experts have been questioned recently about the efficacy of systems in development. Some [physicians worry about the new AI systems](#) in the hands of consumers. For example, The U.S. Food and Drug Administration recently approved two heart health apps, but doctors voiced concerns the apps could lead to unnecessary anxiety—and overcrowded waiting rooms. The bottom line: Humans will make errors. AI and ML systems will do the same.

IT infrastructure modernization is needed. AI will require investment in technologies that complement or replace legacy systems. After all, the amounts of data that ML systems need is immense, too much for traditional databases. Healthcare leaders will find AI and ML will be most effective with a digital infrastructure that can extend to wherever data resides—in on-premises data centers, hybrid or multi-clouds. That’s why although some organizations implement AI on premises, the majority are moving to the cloud and to a new way of working that includes DevOps, continuous integration and continuous deployment (CI/CD), and a cloud-native architecture of containers and microservices. While these may be perceived as challenges upfront, the long-term benefits of possessing the right digital foundation far outweigh doing nothing—and not being able to take advantage of AI’s power today and into the future.



Putting It All Together

Healthcare organizations' reasons for pursuing digital transformation are varied—from improving care quality and delivering better clinical outcomes, to improving care coordination and reducing readmission rates—yet emerging technologies such as 5G, IoT, and AI move them closer to reaching their patient-first health, business, and financial goals.

“With 5G, IoT, and AI, we see the opportunity for greater telehealth services that lower costs while impacting communities that are otherwise underserved, creating ways to get patients' lives covered and care for entire populations.”

CHRIS LOGAN, HEALTHCARE INDUSTRY STRATEGIST, VMWARE

The speed, bandwidth, and low latency of 5G will accelerate full-scale IoT, and AI and ML will be able to leverage the vast amounts of data that IoT generates to develop more meaningful models. For healthcare organizations that possess software-defined, digital foundations—which support any cloud, any application, and any device—adopting these emerging technologies as they come will be a simpler, automated, and more secure way of transforming the continuum of care, from the waiting room to the operating room, to the living room.

[Learn more](#) about how VMware is successfully driving emerging technologies adoption in healthcare to improve the cost, quality, and delivery of patient care.

