Hewlett Packard Enterprise

medicine.nxt

As medical technology becomes more patient-centric, outcomes are likely to improve.

EDITED BY DAVID CHERNICOFF

TABLE OF CONTENTS

Medicine.nxt

Introduction

Introduction

The digitalization of healthcare is providing a better healthcare delivery experience for both patients and clinicians. That means doctors, nurses, and caregivers can spend more time being doctors, nurses, and caregivers and patients can spend more time being people.

It also means healthcare providers can let technology melt into the background while they are treating patients. It means data can travel and be stored quickly and safely, rather than clinical teams having to travel to the data they need. It means cost savings using modern AI to predict cost spikes as well as more effective clinical management and planning. It means systems both old and new are secure, preventing loss of patient data and the damage and embarrassment that comes along with that.

For patients, technology has the potential to provide access to healthcare at all times and in all places—anywhere in the world people can access a network. With the digitalization of healthcare, patients don't need to visit healthcare facilities as often, and when they do, smart spaces in hospitals and other clinical settings make visits more efficient, streamlined, and relaxed.

But what might healthcare look like for people in the future? What if your dietitian or general practitioner could examine your diet and prescribe foods that could be freshly cooked by your IoT oven, not only helping you become healthier, but also giving you more time to spend doing more of what you like to do.

All this relies on having hybrid IT and Intelligent Edge technology that provides a fast, secure, and available platform, so that doctors are not waiting for slow systems and can focus on quality patient interactions. Patients can use such technology to meet their healthcare needs quickly and efficiently, whether they are being treated in inpatient or outpatient settings or for immediate care or long-term complex conditions. ■

01

Medicine looks to technology to improve the future

- Tech improves all aspects of patient care
- Specialized tools make for rapid diagnosis
- Faster data analysis reduces human workloads

Digital pathology set to speed diagnoses, cures

A picture may be worth a thousand words, but digital pathology is potentially worth a billion cures. Here's how it works.

Digital pathology is the next step in digitizing patient records in the shift to personalized medicine. Until recently, lab results generally were recorded as text in the patient's electronic medical record (EMR). When a diagnostic image was added to the EMR, it was usually as a static picture rather than as a rich set of digital data that can be mined and analyzed by analytics software.

But that situation is changing rapidly.

Digitizing microscopic images requires the use of digitized glass slides and specialized scanners. The result is digital pathology: a dynamic, image-based environment of the captured information that can be interpreted and managed as digital data.

> Digital record-keeping allows doctors to dynamically diagnose patients.

In other words, a picture of whatever is on the slide is only one possible visualization of the data that is captured in this way. The data can be mined and analyzed, and the array of results can be presented in numerous visualizations for myriad uses.

Machine assistants for pathologists

Working with images that are so complicated and varied is highly complex. Diagnostic clues are often nuanced and veiled, and sometimes missed by the human eye.

Think of the millions of possible images of slides that are viewed under a microscope every day. Now think of the trillions of total slides pathology professionals worldwide view through the course of their combined careers. It is obvious how easily something could be overlooked or misidentified.

The medical information load is staggering, yet each image and pathological report generated is essentially used only once and for one purpose: a single diagnostic instance in a single patient. That amounts to an incalculable number of missed opportunities, both in terms of helping individual patients and in adding to the general medical knowledge base. While human pathologists have saved many lives using whatever tools they have had to work with, historically, that traditional method represents massive inefficiencies.

More patients can be saved using new tools such as computerized vision and artificial intelligence in conjunction with digitized data. Digital pathology can provide new, life-saving tools that rely on a growing pathology knowledge base, further refining medical discovery in diagnostics.

Another issue driving digital pathology is the continuing shortage of human pathologists. Machine assistance is a practical way to ensure that all patients get the correct diagnosis in the fastest amount of time.

The end benefits to patients are faster and more accurate diagnoses, faster and more accurate treatment, and less stress while waiting on test results, to name but a few.

On the professional side, some of the ways digital pathology can help pathologists in their real-world, day-to-day work are:

- **Lightening the workload.** By automating much of the basic diagnoses via digital pathology and analytics, routine diagnostic work no longer clogs the pipeline. This frees pathologists to work on the difficult cases, where their talent is most needed.

MORE PATIENTS CAN BE SAVED USING NEW TOOLS SUCH AS COMPUTERIZED VISION AND ARTIFICIAL INTELLIGENCE IN CONJUNCTION WITH DIGITIZED DATA.

- **Speeding turnarounds.** Faster delivery of results to healthcare providers means patients are treated quicker and more accurately. This can also help stem the rise of antibiotic-resistant microbes if diagnosis is confirmed before antibiotics are prescribed. Of course, some tests take longer than others, and healthcare providers will still need to act promptly and preemptively. But many times, diagnosis is delayed by pathologists' backlogs.

- **Making it easy to share.** Getting pathology information to specialists quickly is crucial, especially when patients have life-threatening conditions. Digital pathology is a fast and easy way to free the data from one physical location, bringing the data to the experts, not the experts to the data.

- **Creating efficient digital reviews.** It's easier to run comparisons, check for errors, and use numerous digital tools to gain further insights if the pathology is digitized. Working with limited information that is manually entered relies on older image processing technology and is subject to human error. This slows processes and increases errors.

- **Improving processes and risk management.** Internal workflows from data availability and governance to risk management and glass management can all be drastically improved.

- **Varying diagnosis models.** Pathologists can choose to use standard modalities, image analysis, or a variety of algorithms to arrive at or confirm a diagnosis. This is likely to greatly improve accuracy.

- **Enhancing ease of integration.** Digital pathology can be integrated with a number of other systems ranging from EMRs and patient portals to ICT systems and insurance reporting tools.

These benefits are achievable by using digital pathology with existing analytics, systems, and tools. Even more can be achieved with the use of newer tools.

Computer vision, machine learning, and AI

Computer vision overlaps with image processing, particularly on the front end, where image processing techniques such as image enhancement and noise reduction are necessary for a machine to see and recognize an object.

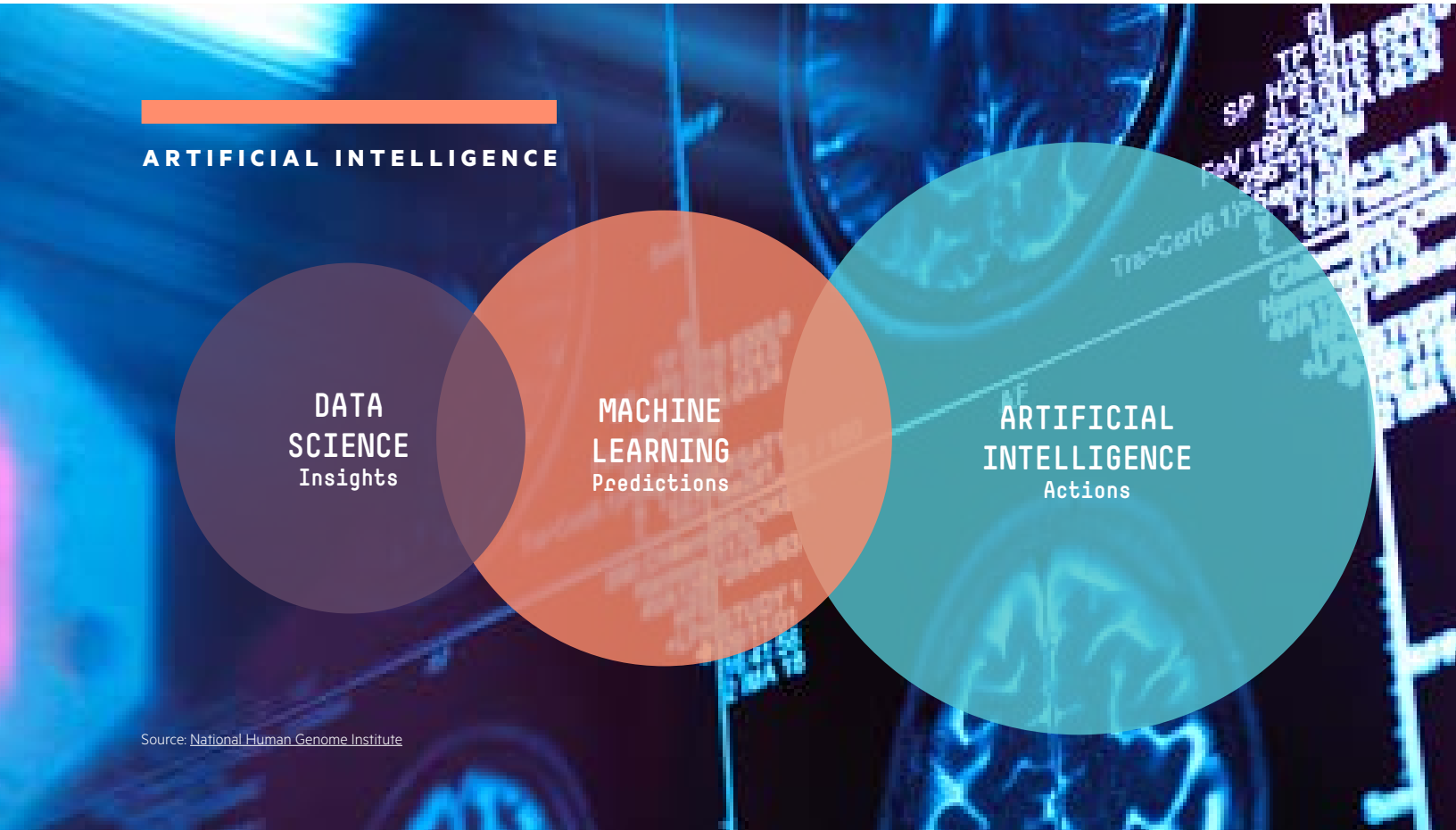
Seeing is a very complex process, yet one that humans typically take for granted. Traditional image processing isn't very good at recognizing more than a few visual objects, if that.

Computer vision seeks to remedy that by attempting to mimic biological systems in how objects are recognized. For example, a cat, a dog, and a child can all recognize a ball, no matter the ball's color, size, or condition (such as brand new, punctured, or covered in mud). Computer vision works to recognize objects in much the same way as the cat, the dog, and the child—that is, through neural networks to create machine learning.

Machine learning is a subset of artificial intelligence; deep learning is a subset of machine learning. Essentially, a machine "learns" by comparing an enormous amount of data and working to eliminate errors until its results are entirely accurate. In the case of identifying a ball, as mentioned above, the software compares every possible depiction and representation of a ball until its ability to recognize a ball is near perfect.

It handles pathology in the same way. It will analyze and compare every possible presentation of Staphylococcus aureus, for example, until it reaches the point where it will always recognize the microbe. In this way, machine learning can also find microbes we humans were not even looking for in the sample, since it can analyze, compare, and learn an almost incalculable number of things in the same datasets simultaneously.

But before any of that can happen, pathology must be in a digital form that machines can use both to learn from and analyze.



Source: National Human Genome Institute

Digital pathology's role in personalized medicine

Personalized medicine, also known as precision medicine, is medicine tailored to a patient's predicted response or susceptibility to a disease.

A patient's specific DNA and epigenetics play a large role in both developing a customized treatment and predicting an individual's response to it.

Take cancer, for example. DNA analysis can reveal a patient's likelihood of developing any given form of the disease. Epigenetics, the mechanism that triggers genes in DNA to turn on or off, have an effect on the occurrence of the disease, its resistance to treatment, and the likelihood of recurrence too. Environmental factors like smoking have an epigenetic effect on lung cancer, for instance. But there are also epigenetic drugs that combat cancer.

> Epigenetics is the mechanism that triggers genes in DNA to turn on or off.

Indeed, there are two new trials underway—one for lung cancer and the other for bladder cancer—to study the effectiveness of combining epigenetic with more traditional immunotherapy treatments. Combinations with chemotherapy are also being studied by researchers at Johns Hopkins. Researchers the world over see epigenetic drugs as the correct path toward an eventual cure for cancers of all types.

Further, DNA vaccines are being developed for several uses ranging from countering antibiotic-resistant diseases to preventing reoccurrence of the specific cancer a patient suffered from earlier. Imagine a vaccine that ensures your cancer will not come back after it's cured the first time!

Digital pathology plays an important role in these medical advances in that it is crucial to identifying the disease and the specific nuances of that individual manifestation of the disease. This data is the essential input in diagnostic algorithms and customized medicine calculations.

Digitized pathology data can also be anonymized and combined with data from other patients to help speed diagnosis for all patients and advance medical discoveries at a much faster rate. In other words, by gathering, mining, and analyzing information from many patients and then

digitally combining it with the patient's digitized DNA and epigenetics, customized treatments, cures, and vaccines can then be made to work for any specific patient. That's what personalized medicine is: customized to the person and the disease to maximize disease eradication and lower or eradicate side effects from the treatment.

Digital pathology applications

We've covered only a few of the reasons why digital pathology is the essential keystone in modern and future medicine. Even so, the list is breathtaking and still growing.

To recap, some of the many applications for digital pathology as it is used today include:

- Primary diagnosis
- Diagnostic consultation
- Intraoperative diagnosis
- Medical student and resident training
- Machine learning
- Manual and semi-quantitative review of immunohistochemistry (IHC)
- Clinical research
- Diagnostic decision support
- Peer review
- Tumor boards

In summary, digital pathology supports education, tissue-based research, drug development, and the practice of pathology. Bottom line: It is an innovation that reduces laboratory expenses, increases operational efficiencies, improves productivity, and enhances treatment decisions and patient outcomes. ■

01 NOW TO NEXT

Digital pathology: Lessons for leaders

Digital pathology will improve the entire workflow of medical care.

Combining the latest in computer technologies, such as machine learning, AI, and high-performance computing, will enable general-purpose use of digital medicine.

Personalized medicine requires these technologies as an enabler.

02

Analytics leads the way to cost reduction

- Predictive analytics improves supply chain management
- The technology enables better facility utilization
- Patients benefit through lower costs

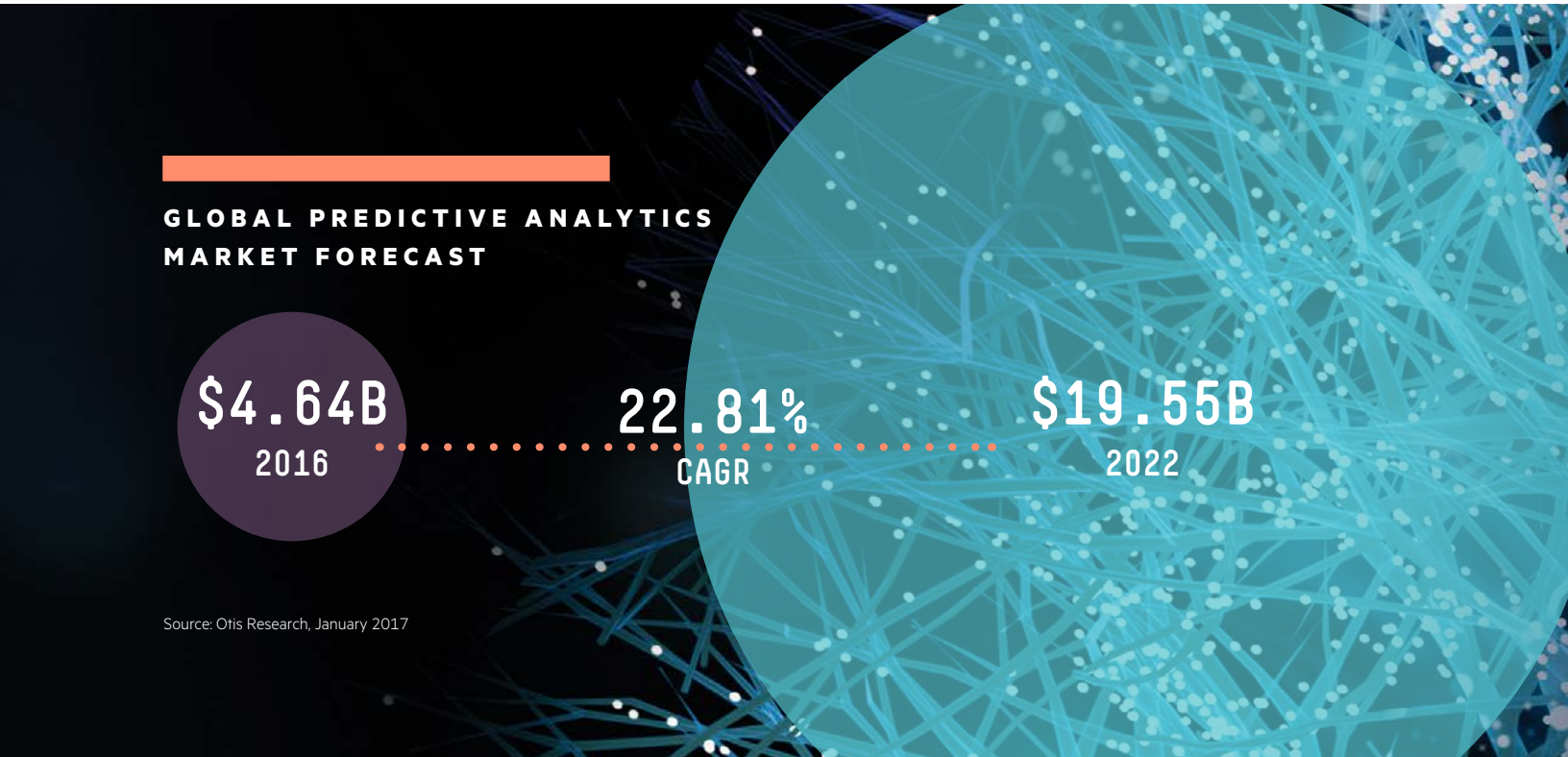
5 ways to cut healthcare costs with predictive analytics

Predictive analytics can help hospitals and clinics meet current challenges and plan for tomorrow's healthcare needs.

Should the man complaining about severe back pain be admitted to the hospital or sent to a clinic? Is the patient who was operated on yesterday likely to develop a serious infection? Are there enough vaccines on hand to cope with a projected flu outbreak? How can staff and facility scheduling be handled more cost effectively? These are just a few of the questions asked by healthcare professionals that can be answered more accurately using predictive analytics.

Healthcare needs help, with costs and patient loads soaring. To cope with these profit-sapping trends, a growing number of healthcare organizations are turning to predictive analytics to control expenses in areas ranging from patient care to stock management to staff deployment.

As the cost and technology barriers blocking predictive analytics adoption fall away, a growing number of healthcare organizations are turning to the technology to improve services and save costs. According to a February 2017 Society of Actuaries report on healthcare industry trends in predictive analytics, more than half of healthcare executives (57 percent) at organizations currently



using predictive analytics expect that the technology will allow them to save 15 percent or more of their total budget over the next five years. Another 26 percent forecast savings of 25 percent or more.

The study also found that a majority of healthcare executives (88 percent) belong to organizations that are either now using predictive analytics or planning to do so in the next five years. Additionally, 93 percent of healthcare executives believe that the technology is important to the future of their business.

Predictive analytics defined

Most business leaders already have a good handle on analytics and the ways data patterns can be studied to improve business performance. Predictive analytics, on the other hand, remains something of a mystery to many managers and executives. Yet the difference between analytics and predictive analytics is really pretty simple: While traditional analytics is typically used to obtain insights on the here and now, predictive analytics helps users peer into the future to forecast likely trends and behaviors. “On the healthcare provider side, users are interested in obtaining specific predictions,” says Brian Murphy, a health strategies and technologies analyst at Chilmark Research, a healthcare IT market research firm.

Predictive analytics utilizes various statistical modeling and other mathematical techniques to scrutinize current and past data and predict what should happen at a specific time based on the supplied parameters. For hospitals and clinics, predictive models can be used to exploit patterns found in historical and transactional data to spot both risks and opportunities in daily operations and patient care.

Models can be configured to capture relationships among multiple behavior factors to enable the assessment of either the potential or danger associated with a particular set of conditions, guiding decision-making for various categories of supply chain and procurement events. “If you’re a healthcare provider, you could, for example, look at all your diabetics and you would know that for your 10,000 diabetics, you’ve got X number of dollars to spend and then figure out the best way to spend that so that you help these 10,000 patients manage their diabetes effectively,” Murphy says.

Much has been written about healthcare predictive analytics over the past few years. Unfortunately, many of the technology’s most vocal proponents have tended to inflate the potential savings while minimizing the time and effort required to deploy and manage a predictive analytics initiative. Still,

there's no denying the fact that predictive analytics is a powerful and highly useful tool that can lead to impressive benefits. Predictive analytics success stories are already beginning to roll in. (It's also worth remembering that healthcare data is regulated. See the U.S.'s Health Insurance Portability and Accountability Act of 1996 and the U.K.'s Data Protection Act for more information.)

Here are five ways predictive analytics cut healthcare costs:

1. Cut rate of hospital readmissions

Unnecessary readmissions are rampant in healthcare systems that frequently leave discharged patients confused about how to care for themselves at home or obtain necessary follow-up care. Readmissions also place an unnecessary burden on healthcare providers who are unable to use the readmission as a new insurance claim and must shoulder the costs. Reducing readmissions promises to significantly lower costs for hospitals. Yet, despite a rapidly growing pool of actionable data, relatively few facilities are using predictive analytics to remediate the problem.

> "The idea of predictive analytics comes in looking for relationships that are consistent with readmission that we would not have predicted or we did not understand before. Once we identify those relationships, we can set up protocols on how to deal with this type of patient and manage things to prevent readmission."
>
> **MARK WOLFF** CHIEF HEALTH ANALYTICS STRATEGIST, SAS INSTITUTE

While there's no single predictive analytics approach to lowering hospital readmissions and its associated costs, several research teams have already created models that address the problem. NYU Langone Medical Center data scientists have developed a predictive analytics algorithm, based on a wide range of clinical factors, that identifies patients who are likely to spend fewer than two nights in hospital. The tool aims to help physicians know when to place a patient on observation and avoid a claim denial from the federal Centers for Medicare & Medicaid Services.

Data scientists at Boston's Brigham and Women's Hospital (BWH), meanwhile, have developed a risk prediction model that's designed to pinpoint hospitalized patients at the greatest risk of being readmitted for preventable reasons. Using data collected between 2009 and 2010 on approximately 9,200 BWH patients, the researchers were able to identify seven factors that best predicted which patients would be readmitted:

- Number of admissions within the prior year
- Whether the admission was elective or non-elective
- Length of hospital stay
- Whether the patient was discharged from the oncology department
- Number of procedures during first admission
- Sodium levels at discharge
- Hemoglobin levels at discharge

Under the model, each predictive factor is given a point value ranging from one, for less important factors, to two or more, for critical indicators. For example, a patient who remains in the hospital for five days or more after admission is given two points.

"In the near term, you can actually have a library of these models that look for relationships between the parameters and the patient as they're going through their care," says Mark Wolff, chief health analytics strategist at SAS Institute.

2. Forecast operating room demands

Operating rooms are expensive to build, equip, staff, and support, so it's in every hospital's interest to optimize operating room use without compromising patient health. To achieve this goal, a growing number of administrators are recognizing that predictive analytics can help hospitals better understand the relationships between the many operating room variables that tend to ruin effective scheduling.

> "When it comes to operating room scheduling, there's a lot of demand that is completely predictable, and predictive analytics can help."
>
> **BRIAN MURPHY,** HEALTH STRATEGIES AND TECHNOLOGIES ANALYST, CHILMARK RESEARCH

These variables include surgeon availability and preference, operating hours, and equipment availability and functionality. With so many factors to consider, creating an optimal surgical schedule isn't easy. Fortunately, predictive analytics can help streamline operating room management. Hospitals are now awash in patient, staff, and facilities data. The trick is to mine the right data, study operating room utilization patterns, and use predictive modeling to match the most appropriate human and support resources with the right operating rooms.

"Demand on an operating room is a kind of forecasting exercise," says Wolff. "We look at historical demand, we look at available capacity and various demographic and macro-economic trends, and then we say whether demand for a particular procedure or a particular variable will go up or down."

Murphy adds, "When it comes to operating room scheduling, there's a lot of demand that is completely predictable, and predictive analytics can help. The difficulty is getting surgeons on board, because for the most part, they want to be able to control their schedule rather than let somebody else control it for them."

3. Add intelligence to pharma and supply acquisition and management

One of predictive analytics' most powerful attributes is its ability to help adopters peek around corners and uncover potential opportunities as well as lurking challenges. Based on data collected over several years, hospitals and clinics can create predictive models that anticipate and coordinate inventory acquisitions in response to expected price increases caused by shortages and inflation,

bargain prices created by market gluts, increased needs driven by seasonal patient intakes, and numerous other factors. Predictive analytics can also be used to reveal internal savings opportunities created by use and waste patterns as well as inventory consolidation and standardization. "One of the main cost factors is drugs management itself, including wrongly managed expiry dates, which is usually a big source of waste. Predictive analytics help you have the right amount of the right drugs at the right time, and that brings strong savings," says Rich Bird, worldwide industry marketing manager for healthcare and life sciences at Hewlett Packard Enterprise.

The supply-and-demand situation in healthcare is much more complex than it is in many other industries, according to Wolff. "There are many situations in a hospital—for instance, in terms of supply and demand with expensive drugs or drugs that require either refrigeration or some special consideration—where optimization of supply against demand can produce greater confidence that you have exactly what you need.

4. Optimize staffing

One of the best ways to trim labor costs is to forecast demand far enough in advance to match staff and resources, thereby reducing the likelihood of incurring last-minute expenses. Although staff scheduling and time/attendance systems have been widely used for many years, they have had only a limited positive effect on overall labor costs and productivity. This is primarily due to a lack of accurate forecasts that hospitals and clinics can use to establish workforce requirements in advance or in real time.

"It's a matter of moving through a calendar that's optimized against an algorithmic schedule versus, essentially, a couple of people sitting down in a room and sort of guessing how many nurses they'll need in what ward based on what they did last week," Wolff says.

5. Minimize costs by maximizing patient care

In emergency rooms and intensive care units, predictive analytics is becoming critical for both quality of care and patient safety. ER and ICU patients are highly susceptible to sudden downturns caused by infection, sepsis, and other critical events. Such incidents are challenging for busy staff members to predict and expensive to treat. As a result, Murphy says, "people are coming around to the idea that predictive analytics leads to more accuracy."

Researchers are now developing ways of using predictive analytics, fed by bedside medical device data, to forecast an emergency medical situation minutes or hours before it becomes a potentially life or death event. At the University of California at Davis, for example, researchers have developed a predictive analytics tool that mines electronic health records (EHRs) to give physicians and nurses an advance alert to patients who are at risk of sepsis, which has a 40 percent mortality rate and is often difficult to detect until it's too late.

A predictive model developed by Atrius Health is designed to enhance care for high-cost, high-need patients. The model is integrated into the organization's EHR system to pinpoint key clinical factors, generating a color-coded banner that flags patients at risk for hospitalization within the next six months.

Physicians can also turn to predictive analytics to help make more accurate on-the-spot diagnoses. A patient entering an emergency room complaining of chest pain, for example, can be evaluated rapidly and efficiently by a physician using a diagnostic tool based on predictive analytics to immediately determine whether or not hospital admittance is required.

Healthcare predictive analytics can also reduce or prevent ICU and ER bottlenecks by analyzing patient flow during peak times, giving administrators an advance opportunity to call in extra staff or make other necessary arrangements before service is adversely affected.

"The common theme here is that there's a tremendous amount of digital data available in hospitals and in the broader healthcare community that has never been available before," Wolff says. "We have algorithms—statistical, mathematical techniques that produce incredible analysis efficiently, with a high degree of confidence—and now we're using that to tackle the problems we've all been dealing with for quite some time in a deeper, more robust way." ■

02 NOW TO NEXT

Three steps to getting started in predictive analytics: Lessons for leaders

Carefully pick the data to be analyzed.

Prepare the data and a predictive analytics model.

Establish the processes for using the predictive analytics model.

03

New tech demands new security

- Hospitals can have up to 15 connected devices per bed
- Hackers use IoT devices to breach healthcare systems
- Medical IoT devices require a “security first” model

Medical IoT devices: The security nightmare that keeps CIOs up at night

Healthcare is among the best reasons for Internet of Things adoption. But IoT security problems can create science-fiction-like damage scenarios. Experts advise how IT can keep medical IoT devices safe and what to do if an attack hits.

Healthcare has been transformed by IoT—for the better. Connected medical devices help improve people's health in many ways, such as allowing doctors to adjust implanted devices without resorting to dangerous invasive procedures, transmitting vital medical data remotely, performing real-time patient monitoring in intensive care units, and much more.

But with those rewards come risks. Medical IoT devices present significant potential security hazards, and they're getting worse. Consider the following:

Medical IoT devices present significant potential security hazards, and they're getting worse.

A survey by security company ZingBox found that U.S. hospitals on average have between 10 and 15 connected devices per bed. A large hospital can have more than 5,000 beds. Every connected device, and the systems managing them, is a target for hackers and malware—and the devices often aren't well-protected.

- A Trend Micro survey found that more than 36,000 medical devices can be scanned and found by a tool called Shodan. And a survey by researchers in Britain and Belgium uncovered security flaws in the communication protocols of the new generation of implantable cardiac defibrillators.
- In 2016, Johnson & Johnson warned patients using its insulin pumps that a hacker could exploit a security hole in the device to overdose them with insulin.

- Former Vice President Dick Cheney had the wireless functions of his heart defibrillator disabled because he was warned it could be hacked in an assassination attempt.
- An exploit called MedJack was found to inject malware into medical devices, and the malware then snakes through the network.
- Forbes reported that the global WannaCry ransomware attack hit medical devices using embedded versions of Windows XP.

This article looks at why medical IoT devices are insecure, examines how widespread the problem is and the potential consequences, and offers advice from the experts on how to secure these useful devices against attack.

Medical IoT devices: Insecure from birth

You might think that Internet-connected devices such as insulin pumps and X-ray machines would be among the most secure of IoT devices because of the obvious potential dangers of them being hacked. But experts warn that these are among the most vulnerable—more insecure than garden-variety PCs, servers, and other business hardware.

Mike Nelson, vice president of healthcare and transportation for security firm Digicert, says one reason for the vulnerabilities is that many connected medical devices were manufactured five, 10, or even 15 years ago, without security planned in. “Many have only very basic levels of security, if at all,” he says.

Manufacturers haven’t devoted many resources to device security. “It’s shocking some of the insecure systems we see being used,” Nelson says. Many of those devices use old, unsupported operating systems that don’t get patched. Many of those devices use old, unsupported operating systems that don’t get patched, including Windows XP or even older versions of Windows, which are insecure and don’t get regular security updates.

Compounding the problem is that medical IoT devices typically require controllers, which are usually PCs or PC-based, says Jon Clay, director of global threat communications at Trend Micro. “Healthcare practitioners tell me that they often cannot patch these systems themselves—if they do, that voids their warranties,” Clay adds. “It’s a real problem when manufacturers aren’t responsive or are slow to issue security patches.”

Manufacturers sometimes put restrictions on putting third-party antivirus software on the devices, points out Thomas August, chief information security officer at John Muir Health, a network of more

than 1,000 primary care and specialty physicians, with medical centers in Concord and Walnut Creek, California. And often, he adds, "the PC and the device itself don't use encryption, which makes them vulnerable."

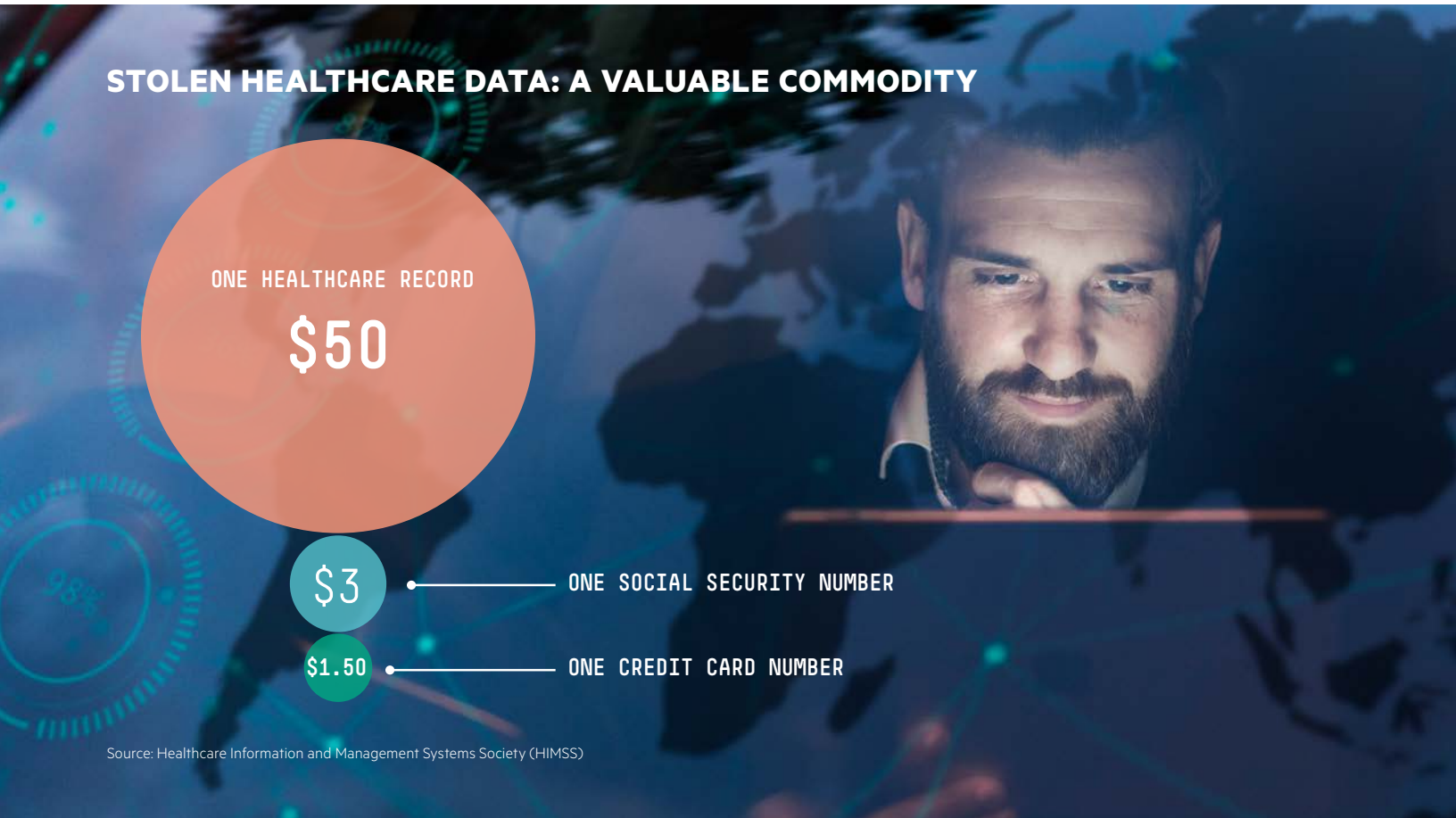
Making things worse: The federal government has been slow to confront the problem. The FDA oversees medical devices and offers suggested security guidelines for them, but those guidelines are inadequate, says August.

"The FDA certifies the device itself but not the controllers, protocols, and cloud access the devices use," he says. "So the oversight falls short."

How and why they're hacked

Clearly, medical devices are tempting targets. But why bother attacking them? Security experts say the IoT device is a way to breach the defenses of healthcare systems. Typically, hackers aren't interested in manipulating the medical devices. Instead, they break into them to get onto a healthcare system's network, from which they can attack or steal valuable information, or plant ransomware.

"Medical devices are low-hanging fruit. They're used as stepping-stones to gain access to electronic medical records, which on the black market are worth at least 20 times more than a credit card record because they contain much more information," says Dr. May Wang, CTO of ZingBox.



Source: Healthcare Information and Management Systems Society (HIMSS)

Wang's estimate is backed up by a report from the Healthcare Information and Management Systems Society (HIMSS), which found that a stolen health record can be sold for $50, compared with $3 for a Social Security number and $1.50 for a credit card number.

The most common form of attack on medical devices is used to place ransomware on a hospital network, she adds, an increasingly common problem. A study by Osterman Research for Malwarebytes found that the healthcare industry has been among the hardest hit by ransomware attacks. The global WannaCry ransomware hack, for example, attacked 40 hospitals in the U.K. alone. That attack also hit medical devices using embedded versions of Windows XP.

Not uncommonly, hackers don't even know when they're targeting an IoT medical device instead of a PC. The hackers use a scanning tool that finds exposed devices of any kind and might not know much more than the device's IP address.

> The healthcare industry has been among the hardest hit by ransomware attacks.
>
> **– OSTERMAN RESEARCH**

Trend Micro's Clay says the result is that medical IoT devices are often merely collateral damage in an attack. "Many attacks have a worm component in them, and that worm is just going to find an IP address. If it has an operating system that it can exploit, it will do so," he says. And given that many medical devices either use Windows XP or have an attached Windows XP controller, they're vulnerable to malware.

The "Homeland" nightmare scenario

The biggest medical IoT nightmare is the hack of a device that can harm or kill a patient. Such a scenario was portrayed in an episode of the TV show "Homeland," in which the vice president was assassinated by someone who hacked his pacemaker and induced a heart attack.

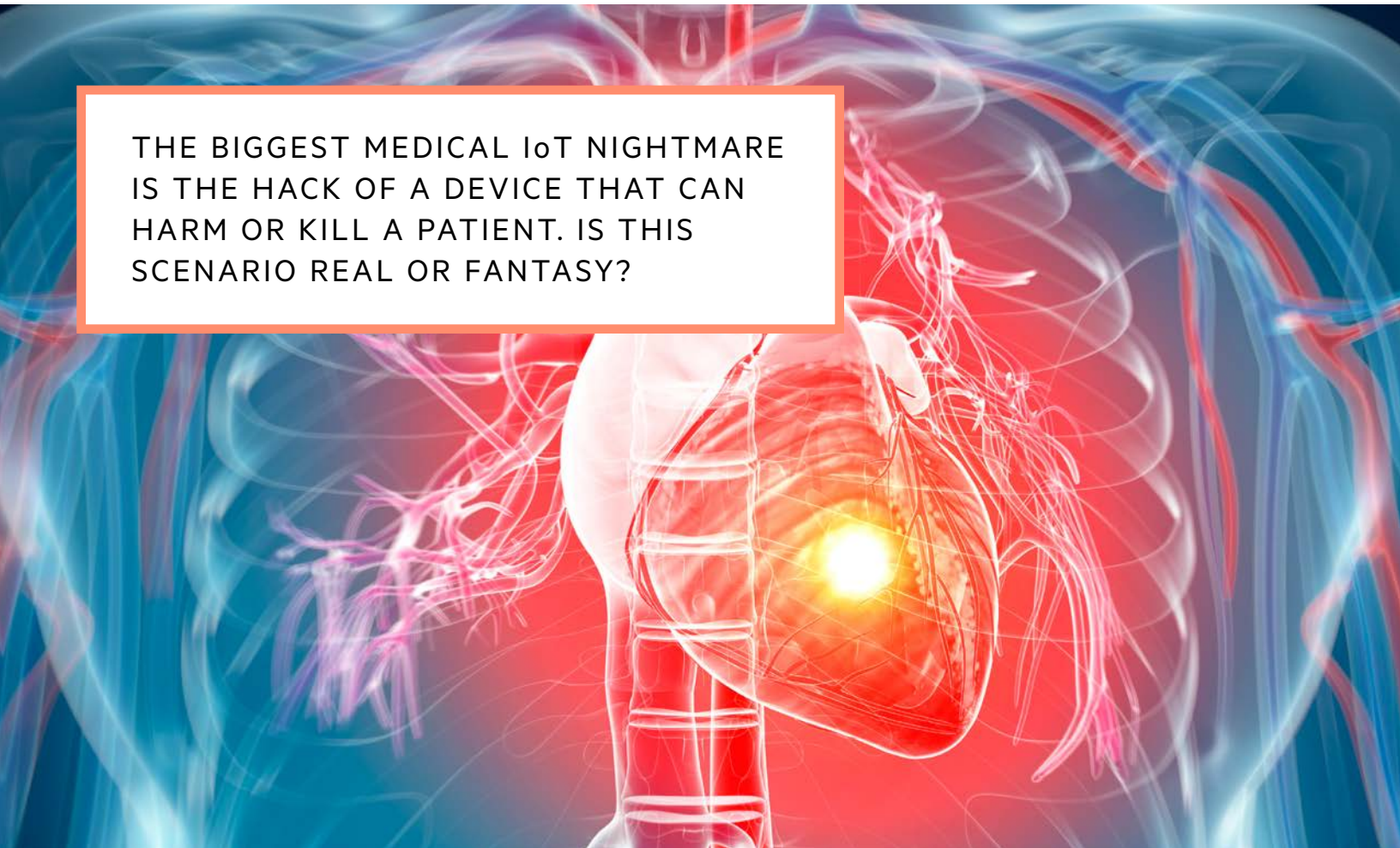
Is this scenario real or fantasy?

It's more real than you might imagine, say experts, although it hasn't happened yet. As mentioned, former Vice President Dick Cheney's doctor was worried enough about such an attack that he recommended the wireless capabilities of Cheney's heart defibrillator be turned off. Cheney followed the advice.

There's plenty of evidence that medical devices can be hacked and remotely controlled by attackers, with potentially devastating results. As noted, Johnson & Johnson last year warned patients that its insulin pumps could be broken into and a hacker could exploit a security hole in the device to overdose them with insulin. ZingBox's Wang says her company has hacked into insulin pumps and IV pumps in its labs and changed drug dosages.

"If you changed doses to an extreme level, it could kill people," Wang says.

There's been no evidence that anything like that has yet happened. And it may never. William Hudson, vice president of IT operations at John Muir Health, notes that medical IoT attacks have a financial basis: either ransomware or stealing and selling medical records. He believes the reason no one has hacked a device and then harmed a patient is "there's not a direct line to a payout—no way to make money from doing it. And if you start harming people, you'll get the FBI involved, you'll get the Department of Homeland Security involved, and that's the kind of attention that hackers don't want."



THE BIGGEST MEDICAL IoT NIGHTMARE IS THE HACK OF A DEVICE THAT CAN HARM OR KILL A PATIENT. IS THIS SCENARIO REAL OR FANTASY?

Manufacturers get serious about medical IoT device security

Given all the dangers, what can be done to protect medical IoT devices? The onus falls on both manufacturers to improve device security and on CIOs and IT to do a better job of protecting the devices once they're deployed.

There are signs that manufacturers now recognize they need to treat security more seriously. Digicert's Nelson says, "I've watched a lot of the large device manufacturers ramp up their cybersecurity teams. As of three years ago, some of them were as robust as zero. But they're now putting into place security checks."

More evidence of manufacturers taking security seriously comes from Dr. Dale Nordenberg, executive director of the Medical Device Innovation, Safety, and Security Consortium (MDISS). Founded in 2010, MDISS is funded by the cybersecurity division of Homeland Security. It helps manufacturers perform device risk assessments, share risk data, and make sure devices are hardened against attacks.

Nordenberg says key to improving device security is having manufacturers share data about cyberattacks, threats, and risks. That way, evidence-based solutions can be crafted using the widest range of information available.

Initially, Nordenberg says, it was difficult to get manufacturers to share that data, "due to concerns about liability and reputation." But in the past two years, he says, "a consensus has been building that there are serious cybersecurity risks associated with medical devices and the delivery of patient care."

As a result, Nordenberg says, a substantial amount of attack data is being shared: "We are now on the way towards establishing evidence-based best practices around cybersecurity for medical devices."

What CIOs, CSOs, and IT can do

Safer devices will go only so far toward keeping medical IoT devices secure. The bulk of the work needs to come from the healthcare organizations that use them.

ZingBox's Wang says healthcare facilities need to address an organizational issue before they can solve the problem. Often, she says, medical devices aren't under the purview of the IT department. Instead, they're handled by a different group, sometimes called the "biomed team" or "clinical

engineering," where the personnel often don't have a deep background in security. Wang says all connected devices, whether medical or traditional IT hardware, should be managed by a single department with security expertise. Only that way can a security plan be put into place to protect them all, including software that can automatically find every device on the network.

Digicert's Nelson adds that the use of encryption and public key infrastructure (PKI) authentication can go a long way toward stopping attacks. With PKI, before a medical device can connect to another device and transmit or receive information, authentication is performed to ensure both devices are trusted—in other words, they're not hackers, bots, or malicious servers.

Perhaps the best advice comes from someone on the front lines of medical attacks. At John Muir's facilities, August segmented medical devices onto their own network, provided special protections for them there, and ensured that if the devices are hacked, the attack can't jump from that segment to the larger network. In that way, medical records, for example, remain secure even if a medical IoT device is compromised.

In addition, August deployed "honeypots" to attract attackers that may break into the segmented network. Doing so gives him early warning that an attack is underway so he can take measures to counter it. In addition, he uses filtering rules and DNS controls to prevent any communication between medical devices and botnet controllers or other external threats.

August also plays hardball with manufacturers to force them to build cybersecurity into their devices. "We've implemented strict contractual cybersecurity terms with our vendors. We let them know that if they violate those terms, we will be reporting that to both the FDA and the FBI," he says.

Finally, August says the healthcare industry needs to band together to make sure vendors make their devices safer and lobby the government to get more serious about taking action to make sure medical devices are cybersecure. ■

03 NOW TO NEXT

Medical IoT devices: Lessons for leaders

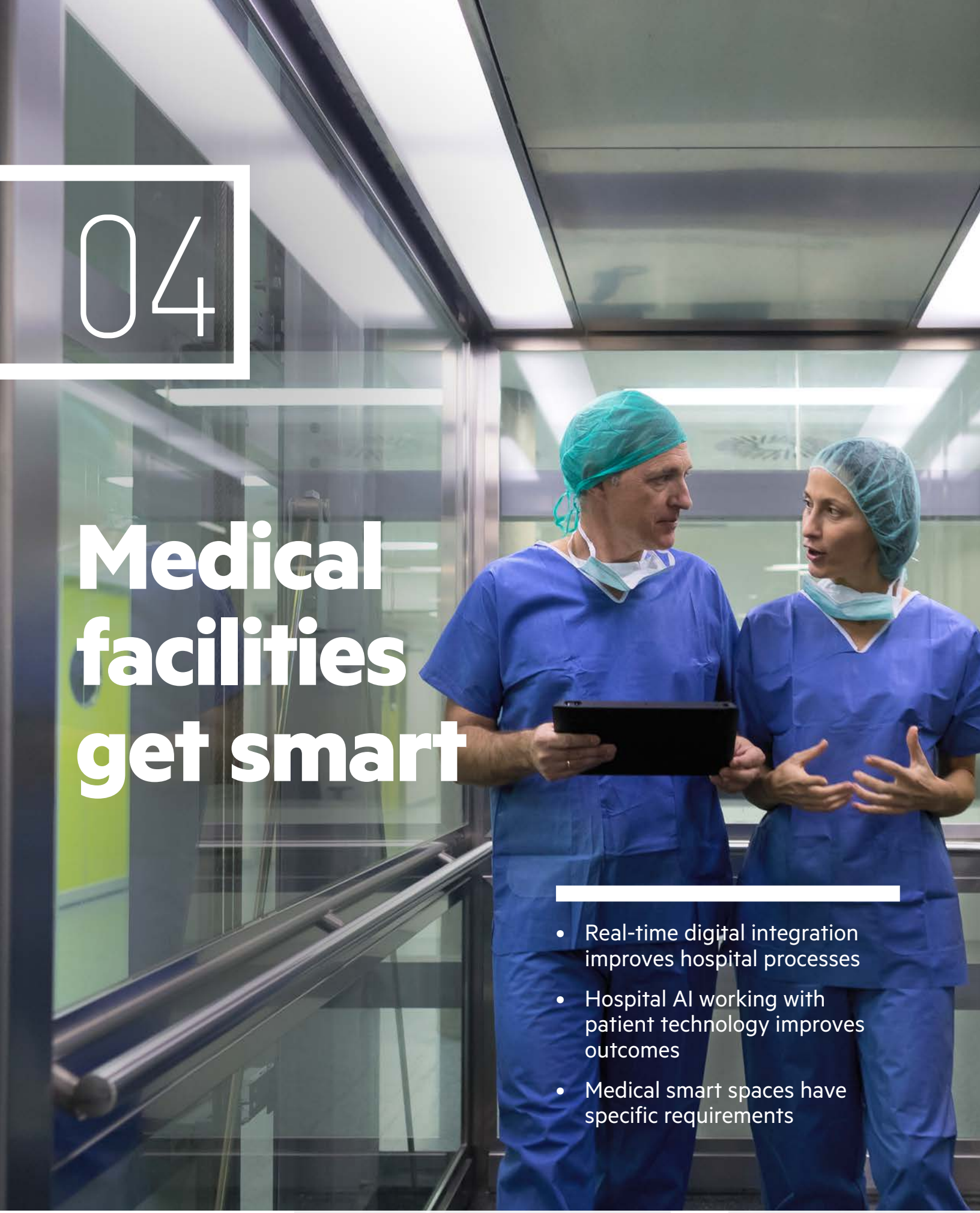
Medical IoT devices are attractive to hackers, generally because it's a way to break into a healthcare organization's network.

Way too many healthcare IoT devices are vulnerable, in part because the manufacturers didn't build in security until recently.

To address the dangers, manufacturers have to improve device security, and IT must establish security practices to protect devices once deployed.

04

Medical facilities get smart



- Real-time digital integration improves hospital processes
- Hospital AI working with patient technology improves outcomes
- Medical smart spaces have specific requirements

Smart spaces, smart hospitals

Great healthcare starts with smart spaces: integrated, modern work spaces that bridge the physical and digital world with intelligence designed to maximize resources while boosting team productivity.

If the average healthcare facility were a human body, its doctor would be very concerned for its health. Healthcare facilities have access to a wealth of resources that are rarely efficiently deployed, resulting in poor organization and a multitude of redundant functions. Patients miss appointments or go to departments they shouldn't be going to at all—for example, emergency rooms are often flooded with patients who have non-emergency conditions. Hospital employees make clerical errors, forcing documents to be manually recovered. Every one of these instances makes a healthcare center less efficient, more expensive to run, and less likely to reach its goals for patient health and satisfaction.

However, as new discoveries in medicine can regulate the function of a human body, innovations in technology can help make hospitals and clinics more efficient and effective. Powerful technologies like mobile communication and the Internet of Things (IoT) can create smart spaces that simplify clerical tasks and empower patients to make better use of available facilities. We are already finding ways to integrate technology into every other walk of life, from work to play, and our healthcare is

no less important. By leveraging new ideas, along with these new technologies, we can improve care facilities and help patients get the best treatment possible.

Get smart

It starts with building smart spaces: integrated, modern work spaces that bridge the physical and digital world with actionable intelligence designed to maximize resource efficiency while boosting team productivity and effectiveness.

Digital disruption is everywhere, including the workplace. Ubiquitous connectivity and the IoT provide new options for collecting and using information about individuals, systems, applications, devices, and work spaces. Hospitals are a case in point: With nearly 8.5 billion mobile phones worldwide, patients, clinicians, and visitors may own four to seven devices each, and as many as 15 devices may be connected to a single hospital bed.

Healthcare facilities are also expensive to maintain, especially when patients miss appointments. No-shows cost the medical industry more than $150 billion a year, with estimates showing the impact on individual physicians can reach $150,000 annually. Meanwhile, patients would be surprised to learn an average of 289 people handle their hospital bills between visit and storage. That means each point of contact has the potential to introduce errors into the system.

All of these problems lead to a staggering amount of waste that could be avoided with the proper application of emerging technologies.

Smart spaces, digital collaboration

We live on the go, using mobile technology for everything from work to romance to answering random questions that occur mid-conversation. Healthcare is arguably more important than any of these mobile use cases, yet most medical providers limit their applications to replicating existing website functionality. That's a great first step—making appointments, emailing doctors, ordering prescriptions, and paying bills are all powerful features to have on a mobile device. But it's only the first step, as this smart, adaptable technology can do so much more than just let us carry the Internet in our pockets.

Mobile technology can empower users to live healthier lifestyles and make smarter use of available healthcare resources. While today's healthcare apps require proactive use, where the patient initiates every interaction from appointments to prescriptions, tomorrow's equivalent could do much of that work on its own. A well-designed system would automatically renew prescriptions and reference the user's calendar to schedule the next convenient appointment in person, via video chat or even house calls by hologram. A patient could easily describe an ailment to an app and have it recommend the most helpful specialty clinic or facility, make an appointment immediately, or even schedule a walk-in appointment or a call with a doctor.

Care facilities can benefit from mobile tools and apps as well. Apps can track travel time from the patient's home to the treatment facility, including traffic conditions, recommend a proper departure time, and even cancel or reschedule appointments automatically if the patient is running late. Or the app could simply ask the user if they will be able to make their appointment. If not, the app will simply plug the next available appointment into that time slot or free up the facility for other uses, saving time and money.

> Mobile technology can empower users to live healthier lifestyles and make smarter use of available healthcare resources.

Mobile technology also goes hand-in-glove with cloud storage, allowing patients and hospitals to keep all medical records, forms, and bills in a single, easily referenced location once regulatory concerns are addressed. Patients can transfer their medical histories instantly from one care facility to another, eliminating the need for transfer fees and complex permissions. Instead of an overly busy system where paper forms can pass through hundreds of hands, digital technology makes it much easier to store, organize, edit, and reference any document, drastically decreasing overhead. At an industrial level, petabytes of digital imaging can be stored in an on-prem private cloud.

Smart care

By putting all our devices and processes online, we come closer to the science-fiction ideal of the house that anticipates the needs of its occupants, the car that knows how its operator drives (or just drives itself), or the hospital where it's impossible to get lost or go to the wrong department. This full-scale integration of IoT into the places where we live our lives creates smart spaces that allow easier and more efficient use.

A hospital or care facility that transforms itself into a smart space could connect to patients' mobile devices to guide them to an available parking spot, through the building itself to the proper department, and even to the shortest reception line. The patient would receive their forms in advance and have them auto-filled, prepaid, and ready to go. They could just go past reception and straight to the waiting room or even straight to their prescheduled exam room. Smart wearables are

already measuring things like heart rate and blood pressure. In the future, smart wearables could help slash pre-appointment busywork so patients can spend more time discussing their conditions with the nurse before meeting their doctor. If needed, the patient's app would lead them to the nearest pharmacy where their prescription would be waiting for them.

The sky's the limit

These are just a few of the ways in which emerging technologies can guide patients through care facilities to make sure they use the proper resources at a useful time, without draining precious resources by clogging up the emergency room. New ideas are constantly emerging to help us automate, streamline, and improve every aspect of our lives. As these innovations make us more and more interconnected, there's no telling how easy and painless we can make the delivery of healthcare moving forward.

Integrating IoT with healthcare

The IoT is the next big leap in connected living. IoT networks can improve the user experience for everything from making toast to checking in for open heart surgery. Here are just a few ways healthcare providers can leverage the IoT to make their jobs easier and improve patient care:

- **Asset tracking:** Just as retailers use the IoT to track inventory, hospitals and pharmacies can use IoT applications to find out which items need to be reordered and where to find misplaced items like ventilator pumps or wheelchairs.

- **Wayfinding:** These applications can provide arrival time instructions and turn-by-turn directions that take into account the entrance or garage through which patients enter the facility. The same messaging and wayfinding features can be provided to visiting or temporary physicians and staff.
- **Push notifications:** This involves pushing a message to each patient, in their preferred language, about the time of their appointment and exact office number. Systems can also push updates about changes in the appointment location or time.
- **Workflow optimization:** By using wireless infrastructure and tag devices like wristbands and ID badges, care centers can track bottlenecks and service slowdowns to improve performance.
- **Data analytics:** Smart wearables can track huge volumes of biometric data that caregivers can use to find out more about both individual patients and populations. Insights from the data can enhance patient care and accelerate lifesaving research. ■

04 NOW TO NEXT

Smart spaces, smart hospitals: Lessons for leaders

Smarter facilities lead to better services.

Digital collaboration reduces costs and improves patient outcomes.

Integrating IoT and edge computing into medical practices leads to more efficient operations.

05

You are what you eat

- Home health monitoring includes diet
- The medical meal kit is on the rise
- Personal IoT devices tie into users' healthcare

Prescription diets and smart machines

We all know that diet plays a huge role in overall health. Will doctors soon be providing grocery prescriptions to be delivered to our doors and prepared by smart appliances?

A proper diet has long been considered essential to good health. But few have the time or skills to follow a diet spelled out on paper and prepare the right foods for every meal. Enter prescription food services ordered by your doctor, delivered by a food service, automatically restocked by your refrigerator, and cooked to perfection by your stove—after it crowdsources the best final touches to the recipe.

In other words, technology can help us eat better. Plenty of studies show that good nutrition prevents diseases ranging from rickets to diabetes and heart problems. The right caloric intake also speeds recovery from illnesses, accidents, and surgeries. Further, more recent research has discovered that diet impacts your epigenetics, the mechanism that turns genes on and off, and thus affects not only your health, but your future offspring's, too.

"Examples of epigenetics in food include the ability of green tea to influence DNA methylation marks and reduce cancer susceptibility, as well as the ability of sulforaphane in broccoli to slow the growth of cancer via histone modification," according to a report in What Is Epigenetics. "Other epigenetic examples even suggest that DNA methylation might fix binge eating early in life or eating brown rice can epigenetically reduce food cravings."

Soon your doctor will prescribe more than medicine to get you healthy and keep you that way.

New discoveries in how food affects your health do not contradict earlier studies, in regard to general impact. The consensus—that the foods you eat and how you prepare them affect your health—is confirmed again and again. Yet the American diet contains a lot of processed and fast foods with little planning based on nutrition science. Processed foods are the opposite of good nutrition, yet their low prices and ready availability make them the most frequent food choices.

Doctors constantly preach against eating processed and fast foods, but many people don't have the time or skills to prepare better meals—and certainly not to choose foods specific to their health needs in the moment.

Even so, the constant public education against fast foods and processed foods is influencing consumers and the food industry.

A "Healthy Happy Meals" bill in New York never passed, but it drew nationwide attention. An American Journal of Preventative Medicine study analyzing food ordered for 422 kids—with an average age of 7—at three popular burger chains found that meals averaged 600 calories, according to USA Today.

The pressure is on to provide more nutritious and lower calorie food for people of all ages, even via a drive-through window. But despite increasing demand for healthier menu items, scoring healthy food is still tough for many people to accomplish, in part due to costs. "Fast food has become a synonym for bad food. Yet, the industrial farm system that has made it possible for McDonald's and many other chains to sell cheeseburgers for a dollar has also enabled Americans to spend a smaller percentage of their income on food than people do in any other country," reports The New Yorker.

The evolution of food service

The Internet is flattening many of our society's institutions, and the food industry is no exception. Online services cut costs by chopping out the middle man and connecting sellers directly to consumers.

Today's food services deliver the precise amount of fresh foods and other ingredients for specific meals. These services evolved from the disruption of the traditional grocery store model. The list of such services is long, including Blue Apron, HelloFresh, Sun Basket, and Home Chef. In each case, everything comes in a box that a couple or family would need for that meal. The appeal is convenience, cooking guidance, good nutrition, and portion control. Cutting out the middle man sometimes helps bring the cost down, too.

Current food services are answering the pent-up consumer demand for healthier foods in greater variety and easy-to-prepare recipes. And they are performing well in terms of meeting consumer health objectives. The next step in the evolution of food services is prescription foods.

So how would that work? And how would it differ from the diets prescribed now?

Prescription food services

Soon your doctor will prescribe more than medicine to get you healthy and keep you that way. That means prescribing technology to help you monitor your condition and maintain your wellness. By this point, the doctor has also diagnosed any conditions you might have and has prescribed a meal plan for you. Food will be delivered and cooked for you with a lot less effort than previously.

Here's one scenario of how that would work: You arrive home, where a box of fresh foods and ingredients awaits you on the doorstep. Everything in that box fits into meal plans that conform to your prescription diet. You may also receive a box of prescribed medical wearables or other devices on your stoop, if you don't already have them to monitor your health. There may even be smart devices in your home capable of monitoring your health, such as a smart toilet and ultrasonic bath that can analyze bodily excretions and scan your internal organs, respectively.

These devices will all report your health metrics on your electronic medical record and alert your doctors to any new information. This information will automatically be carried over the Internet from a pre-configured Wi-Fi router in your home, via apps on your phone and other devices.

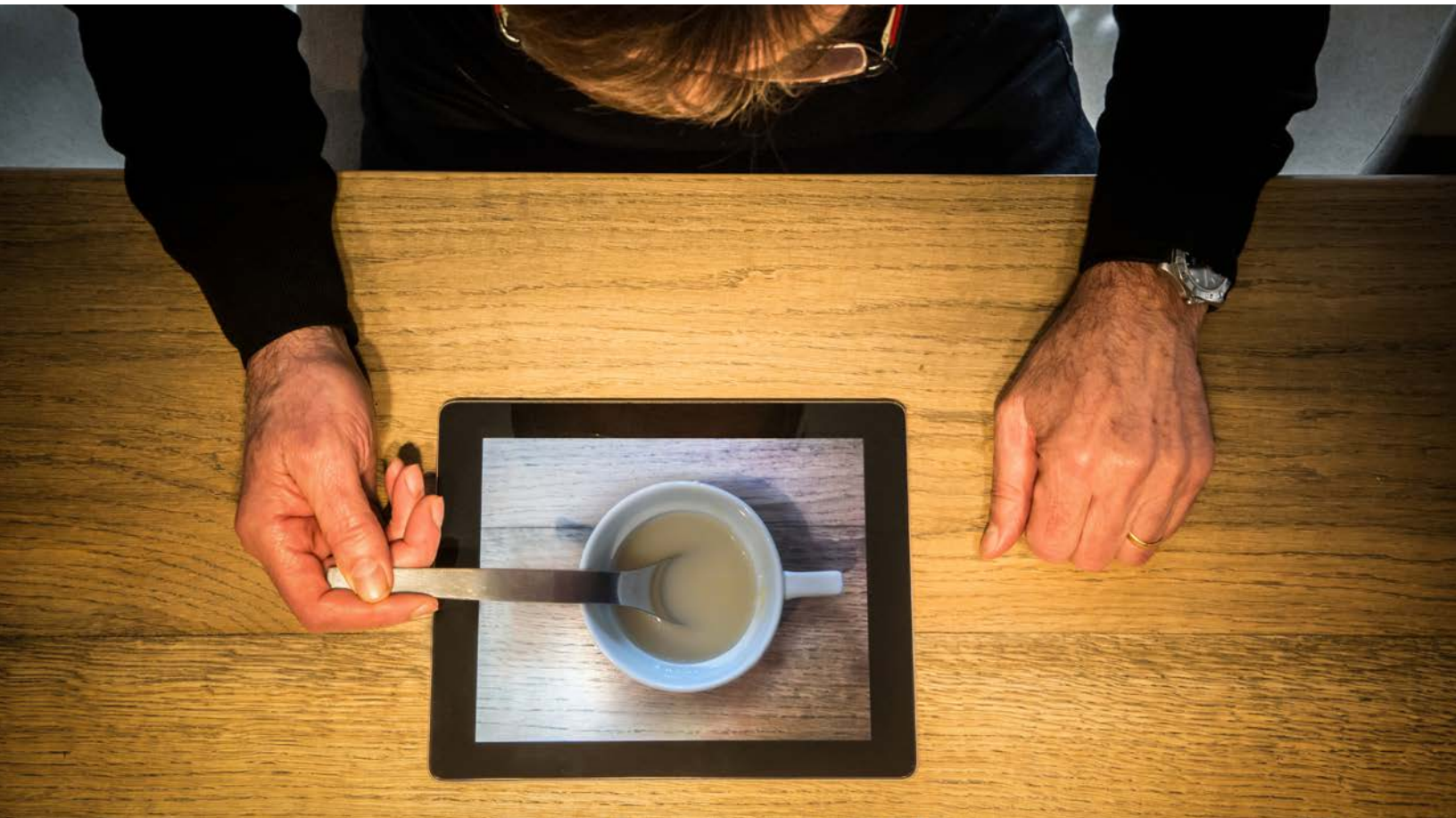
Your food, prescribed for your unique health condition and delivered to your door, can be cooked by (or with the help of) integrated smart devices and intelligent assistants, something akin to Apple Siri, Samsung Bixby, Amazon Echo helper Alexa, and Google Assistant.

After all, having the complete meal kit sent to your home eliminates the need to shop, but some people may still have trouble preparing the meal without assistance. Intelligent assistants can help with instructions and examples, but smart devices can help with the actual work.

The rise of machine chefs and home health monitors

One class of such devices is Internet-connected ovens, which are already on the market. Many have met with positive reviews. One example is the June oven, which asks a series of questions about the meal to be cooked and then, using a complex array of sensors, cooks the meal to the specifications set by you—or based on the best practices of other cooks reporting back in the cloud on the success of their experience.

Another example is the Tovala smart oven and subscription plan. Meals arrive at your door already prepared—seasoned, marinated, or chopped as needed. You just pop the trays into the smart oven, scan the tray sleeve to give the stove its instructions, and press start. The oven cooks the recipe perfectly—by itself. You can also cook your own recipes in it.



Your smart refrigerator will ensure you are stocked with foods and ingredients that match your prescription diet, and suggest recipes based on what you actually have on hand. The resulting tasty dish is then cooked in your smart oven, and your intelligent assistant will handle the stove settings appropriately for that dish.

If you decide to go out and eat with friends instead, your smart refrigerator will perfectly store the foods that were delivered at precise temperatures. Your phone app will take over and suggest restaurants that have the foods you were prescribed to eat. When you arrive, the phone app will have already analyzed the menu and make suggestions on what to order. If you like, it will actually make the order for you.

When you get back home again, smart devices will measure your health and report to you and your doctor. For example, the smart toilet will tell you your weight and muscle tone, while a smart camera connected to Amazon's Echo will tell you if your clothes still fit properly. Did you lose weight on your prescribed foods? Echo will suggest how you can adapt your current wardrobe to still fit or where you can find new clothes on sale. Would you like the new clothes delivered to your door as well, Echo will ask? If you do, Echo will order what you need from Amazon or another store of your choosing.

Cheater penalties

While all of this is certainly convenient and probably very tasty, no doubt some people will at least occasionally cheat on their diet. The new technologies will report such to your doctor and adapt your food plan to make up for the transgression.

But humans being human, cheating on a diet is to be expected. Smart healthcare providers will likely accommodate this tendency to cheat by providing a prescription for foods that stop or reduce urges. How can that be done? Big data and personalized medicine to the rescue!

Personalized medicine is all about fitting a customized prescription treatment to the patient and that includes predicting urges and weaknesses for certain tastes and chemical substances found in foods, such as sugar and caffeine. Penalties are therefore not much of a concern, unless you count a possible impact on your health insurance premiums for failing to comply with your food prescription. But in general, it will be a pleasant experience both in terms of dining and health outcomes. ■

05 NOW TO NEXT

Prescription foods: Lessons for leaders

Prescription food plans integrate smart devices.

These provide real-time monitoring of health and food intake.

They decide what to do with the information gathered with the patient's best interests in mind.

06

Healthcare's digital future

- Better technology will reduce waste
- Wearable tech will be integrated into users' healthcare
- Advances will streamline and improve processes

How to connect to the digital patient

Learn how advances in healthcare technology and IoT devices could revolutionize preventative care and personal wellness.

Fortunately, digital solutions are available to improve our healthcare experience, empowering "digital patients" who leverage new technologies to improve their day-to-day health, reducing their risk of serious illness as well as waste throughout the medical industry. Databases and machine learning can usher in a new continuum of care where a doctor is not required for basic needs like changing prescriptions, noticing new conditions, or updating medical records. Freed from these basic tasks, clinicians see their bandwidth expand as if by magic to handle the issues for which their expertise is really needed. By empowering patients and liberating doctors, technology can reinvigorate the global healthcare ecosystem.

Digital healthcare can help eliminate waste

Poor day-to-day management of personal wellness is a major source of waste in the healthcare industry. Digital innovations can mitigate or even eliminate these issues, saving money for providers and improving quality of life for patients. Mobile technology, artificial intelligence, the Internet of Things, and data mining can make every patient the orchestrator of their own healthcare through

telemedicine and health tracking devices. Such technologies can create smart spaces to guide users through a more efficient and cost-effective healthcare experience while saving the medical industry over $8.4 billion every year.

> According to the World Health Organization, 20 to 40 percent of all healthcare spending is wasted.

A recent study found unnecessary trips to the emergency room cost $4.4 billion annually and 17 percent of all hospital visits could be addressed more efficiently at an alternate health facility. Meanwhile, proper preventive care could save $4 billion—not to mention 2 million lives—a year. When patients don't receive smart preventative care and don't know where to go for routine care, they end up suffering needlessly and creating undue overhead for their provider.

Digital to the rescue

This is where digital solutions can save the day. Our connected world is constantly offering new innovations to help us reduce stress and streamline tasks. The average patient or care provider in a developed market could leverage a whole fleet of digital resources to easily and non-intrusively shape a satisfying and proactive health routine. By integrating biometrics, cloud technology, the IoT, and mobile access, healthcare providers can set up both simplified and unobtrusive healthcare protocols to guide patients through their routines and help them integrate with "smart cities," enabling patients to have healthier, happier interactions with their environments.

Under the hood

Knowledge is power, and the healthcare procedures of the future will rely on information from each patient, stored independently and aggregated with that of all patients to make self-care easy and intuitive. The integrated wellness platform will store information like medical records, purchasing history, autofill forms, and more while collecting data from smart wearables that track vital signs.

All of this information will be logged and analyzed before being passed up to a hybrid cloud to be cross-referenced constantly with similar use cases, constantly updating both worldwide records and

the patient's own best practices. As the database expands, patients and providers worldwide will have access to more precise and detailed information, making every subsequent reference faster and more accurate.

Healthcare wearables and ingestibles will reinvent preventative care

Imagine a patient wakes up in the morning and has his smart wearable check his heart rate while a safe device he ingested (a smart ingestible) monitors internal signs to make sure nothing is out of the ordinary. An ingestible could even check for changes caused by medication, to warn of possible side effects, or remind the user to take any prescribed medicines it does not detect. A smart device could keep track of nutrient intake and suggest healthier snacking habits, taking the Fitbit's idea of monitoring and encouraging exercise to new heights. The system would automatically order prescription refills and—if current meds aren't helping—ping the doctor for alternative prescriptions.

Smart devices could notice the symptoms of illness before a user even gets the sniffles and report any symptoms to the appropriate doctor, log the symptoms in a database, and support clinicians in prescribing immediate care options, all while determining what sort of facility or specialist could best provide aid. To make the next convenient appointment, the device would use its knowledge of the patient's routine for scheduling either an in-person or online appointment. At the care facility, the patient would be guided to a parking space, led to the proper department, and have all their forms autofilled and signed with a fingerprint in advance.

Patients can go about their lives comfortably and with only occasional interactions with healthcare details, the pressure of tracking and organizing them taken off their own shoulders and instead given to an elegant and tireless connected system.

Integrated health monitors and apps will streamline care

And that's just the way a mobile system can ease organizational woes. With the power of data mining, analytics, and AI, every patient can have a proactive digital healthcare assistant help find the best path to wellness. Today, apps for smart watches and other wearables can track heart rate, blood pressure, and daily step counts, but that's just the beginning.

A healthcare app that integrates with a patient's other software can find out what kind of food they like and suggest healthy alternatives, maybe even at their favorite restaurants or places within walking distance. Integration with citywide monitoring could create so-called smart cities where a user taking the bus home might have their healthcare system suggest getting off a stop or two early to get a bit more exercise, while someone with breathing issues could be steered away from polluted areas.

As biometric technology improves, wearable and mobile devices will be able to monitor more and more vital signs, logging any abnormalities or problems and referencing an ever-evolving, interconnected database of similar symptoms to find a solution in seconds, not days—maybe even before the wearer knows anything is wrong. Wearables could detect sleep apnea without the need for a sleep study, notice elevated glucose levels in a diabetic, or even detect the first signs of cardiac arrest and notify emergency services.

Tomorrow's solutions today

Health is simply too important to be tossed into the jumble of day-to-day planning, potentially overlooked by harried, busy people. New technology can create a paradigm shift in the provider's role from being necessary at every minor step to being able to help with the major issues while a smart automated system sweats the small stuff.

Greater digital integration and the proactive leveraging of new technologies is the way forward when it comes to providing the majority of day-to-day attention, helping patients manage their own wellness before they ever have to step into a medical facility and making such visits as painless as possible for both caregivers and their charges. We already have access to solutions right out of science fiction—it's time we started using them to improve present-day healthcare. ■

06 NOW TO NEXT

4 ways to encourage wellness: Lessons for leaders

Prescribe digital solutions like apps as well as treatments to help patients manage their healthcare.

Encourage patients to join communities for people with their condition for advice, support, and solidarity.

Use micro-achievements and incremental rewards to keep patients invested in their treatment.

Leverage behavioral ("nudge") economics to steer patients toward healthier choices, such as by preselecting more healthful options on apps and requiring a patient override.

The future is now

Changes in healthcare are coming rapidly, and many of the questions being asked deal with how society and governments will be able to handle the necessary combination of privacy, knowledge, and data security that the next generations of medical technology will demand.

The far-reaching implications of regulatory standards such as HIPAA and GDPR are going to impact the easy flow of data between doctor and patient. It remains to be seen just exactly how this will be handled in the future and what impact it will have on patient care, long-term health monitoring, and real-time health analysis. ■

CONTRIBUTORS

Rich Bird

Rich Bird is the worldwide marketing manager for healthcare and life sciences at Hewlett Packard Enterprise. He is a strategic thinker who understands the practical elements that are required to get the job done and deliver real business value. His areas of specialization include healthcare IT, marketing, communications, and NLP.

John Edwards

John Edwards is a veteran technology writer. His articles have appeared in CIO magazine, CFO magazine, Computerworld, Network World, RFID Journal, IEEE Signal Processing Magazine, The New York Times, The Washington Post, Defense Systems, and Defense News/C4ISR. He has also authored several business-technology books for major publishers.

Preston Gralla

Preston Gralla is a freelance writer and author who has written thousands of articles and nearly 50 books about technology. His work has been published in Computerworld, PC World, PC Magazine, USA Today, the Dallas Morning News, the Los Angeles Times, and many others. His books have sold hundreds of thousands of copies worldwide and been translated into nearly 20 languages.

David Chernicoff

David Chernicoff is a managing editor at Enterprise.nxt, covering the intersection of IT and business strategy. He brings close to 30 years of experience in IT to his writing and editing. After running testing labs for major magazines in the 1990s, he went off on his own, providing consulting services to businesses across the SMB market while writing books, magazine articles, and blogs on topics as diverse as desktop migration and data center energy efficiency.

Read more about the tools you'll need to accelerate your organization's transformation from now to next.

Visit insights.hpe.com

enterprise.nxt

Hewlett Packard
Enterprise

a00063521enw

SHARE THIS WITH YOUR NETWORK