HealthData
Management

It was a typical early Sunday morning in the Erie County Medical Center emergency department. Then, at 2 a.m., a message flashed across a workstation demanding payment to restore the computer's memory. The staff quickly realized it was a ransomware attack. The question was: Could the threat be contained?

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Liberty Solutions stays ahead of the curve with new ideas for its health data management clients.

SAM VIOLANTI
President
Liberty Solutions, Inc.

Founded in 2002, Liberty Solutions continues to establish a wide footprint across the United States, providing expert application and clinical transformation services for healthcare IT clients large and small. The secret to the company's success is simple – evolve.

According to company president Sam Violanti, that means Liberty Solutions continues to evolve as a company, investing in infrastructure, adding quality steps and presenting clients with new ideas in service to better match their needs.

"Keeping up in an industry that's constantly advancing is a challenge," Violanti explains. "But by anticipating and being aware of changes as they are happening, Liberty Solutions has maintained our position at the forefront of healthcare IT consulting."

Managing more data.
Violanti notes that patients today generate huge amounts of information, from diagnostic imaging to blood test results, and IT technology helps make patient care easier and more efficient. Industry experts say the quantity of information will only increase, especially as new technologies such as wireless and portable devices are used more and more in healthcare. While healthcare organizations in the United States have installed countless IT systems for data management and electronic records keeping, these systems must be able to handle constant changes in how information is exchanged.

The need to manage more data presents one example of how Liberty Solutions has evolved its services for healthcare IT clients. "Over the past few years, we have helped more clients ensure that their existing IT systems are able to integrate with emerging technologies and handle the increased data through system optimization," Violanti says.

> *"… we listen and create new ways to help the client save time and energy in solving healthcare IT challenges."*

Liberty Solutions consultants can help make adjustments to optimize IT systems to handle workflow changes and such that result from all the data that needs to be managed. The company also has expertise in helping large healthcare organizations transition to new EMR systems. Ultimately, improved clinical and financial outcomes will result from optimizing IT systems to handle the growing data demand.

Matching specific needs.
While increasing patient information is a common denominator, Violanti says no two healthcare organizations are exactly the same. That is why Liberty Solutions has invested in its recruitment efforts to work with the best consultants who can be better matched to a client's particular needs.

"Our resources have experience in laboratory, pharmacy, nursing and other healthcare settings, giving them a big picture understanding while enabling them to focus on specific areas," Violanti points out. "We have systems in place to make consultant placement even more precise as we can tap into any skill set the client requires."

Flexibility in service
Core team members at Liberty Solutions have more than 25 years of experience in healthcare IT on both the client side and the consulting side. In fact, upper management members still do consulting in the field.

They understand projects inside and out, including the challenges clients face on a daily basis. Having this perspective led Liberty Solutions to offer flexible, ad hoc services that enable clients to pay only for the services they use.

"We offer many types of agreements to meet the client's exact project needs, including part-time contracts that allow them to utilize our expert services on an 'as needed' basis," Violanti concludes. "Our services have evolved because we listen and create new ways to help the client save time and energy in solving healthcare IT challenges."

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INSIDE

Working with artificial intelligence at the Cleveland Clinic, from left: Christopher Donovan, executive director of enterprise information management and analytics; Joe Dorocak, senior financial analyst; Michael Lewis, senior director of healthcare analytics.

PHOTO BY ANGELO MERENDINO

INSIDE/DEPARTMENTS

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Ken Arnold, Analytics Manager, Covenant Healthcare

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Dimensional I N S I G H T

editor's NOTE

AI: Moving from hype to reality

HEALTHCARE IS NO STRANGER TO THE infamous Gartner hype cycle. As a journalist covering the industry, it's sometimes intriguing to figure out where an emerging technology is on this graph, which charts the typical cycle from moment of innovation for an new technology until it starts producing results.

Artificial intelligence is making its way along the ups and downs of the hype cycle. Right about now, AI appears to be near the peak of inflated expectations, perhaps slipping over the precipice onto the downward slope toward the trough of disillusionment.
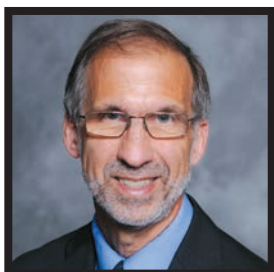
Most HIT executives know the pattern—they've seen overhyped expectations for new technologies, where hopes and dreams obscure the hard work that lies ahead. For example, high expectations surrounded the Internet and electronic prescribing in the late 1990s, but it took years before those technologies matrured. Only after early dreams are dashed does the real work of innovation, and achieving benefits, set in.

I'd like to suggest that there's a concurrent cycle of exaggerated hysteria with new technology. I saw this during the past two RSNA conferences regarding AI. In 2016, AI was the monster to be dreaded, because radiologists feared it would obviate the need for them to interpret images. Last year, however, those fears were nearly gone—and nearly every vendor insisted that it had incorporated AI into its products.

Expectations for AI in healthcare are high, particularly when it comes to expectations for achieving measurable improvements in patient care and financial performance. However, reality is hitting home—there are many stumbling blocks to overcome before advanced decision-aiding technology is widely adopted, reports Linda Wilson in our cover story for this issue.

In her reporting, Wilson notes that Paul Chang, MD, professor and vice chairman of radiology informatics at the University of Chicago School of Medicine, says "We are not at the solution level yet; it is a long way between initial promising results in the lab and true clinically validated solutions." But early work on using and benefiting from AI is under way, she finds. Her story begins on Page 16.

AI is competing for IT resources with other IT initiatives, and one of those involves information security. Attacks on providers are commonplace, and instances of ransomware attacks have been increasing over the past two years. In this issue, starting on Page 20, Managing Editor Greg Slabodkin takes a microscope to examine the attack last year on Erie County Medical Center. Recovery from the attack was extensive, time-consuming and expensive, and ECMC used many workarounds to ensure care could be delivered safely to patients.

Slabodkin's account of the story is insightful, and we applaud ECMC for allowing us to tell its story. Such openness to share information with others in the industry is crucial in allowing provider organizations to inform others about hacking gambits and best practices at defense and recovery.

Fred Bazzoli

Fred Bazzoli
Editor

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NEWSLINE

SECURITY

Ransomware Hits Allscripts

Malware attack leaves 1,500 customers without access to cloud-based EHRs, other systems.

A cyberattack employing ransomware in mid-January crippled cloud-based services provided by Allscripts, one of the nation's largest electronic health records vendors.

The Chicago-based company said services to 1,500 healthcare organizations—primarily small physician group practices—were interrupted for several days. It reported that all services were fully restored to all customers on January 26.

Customers vented their anger on social media, and one class action lawsuit already has been filed against the company.

Allscripts' problems began January 18 when a variant of the SamSam malware affected two data centers hosting its Pro EHR system and the electronic prescribing of controlled substances software. In communications with customers the next day, Allscripts said it was attempting to "restore both the directly affected services—hosted Pro EHR and hosted EPCS—and the other unaffected services that we proactively shut down to pro-

tect clients and client data."

Northwell Health, a 22-hospital delivery system in New York, was affected by the Allscripts breach, although a company spokesman contends the impact on the organization was minimal. "When we learned of the attack, we disconnected from data centers as a precautionary measure," he says. "We lost e-prescribing for controlled substances, but other systems were secure and never at risk."

During the outage, the New York American College of Emergency Physicians advised its 2,300 members they were allowed to use "paper official prescriptions" until services are restored.

Legal action against Allscripts began almost as soon as the attack was fully resolved. Surfside Non-Surgical Orthopedics in Boynton Beach, Fla., filed a class action complaint, charging Allscripts with failing to secure its systems and data from cyberattacks, preventing clients from conducting routine and ordinary business. *—Joseph Goedert*

Newsline

Apple Update to Enable Users to See Health Records on iPhones

Few Patients Using Telehealth

Hospitals and healthcare delivery systems see telehealth as one way to facilitate treatment, and make it quicker and faster for patients. However, consumers may not be embracing the concept as rapidly as these organizations would like.

A recent survey finds that provider organizations are making commitments to provide services via telehealth—they've made substantial investments in infrastructure, training and process reengineering. But the survey, found that eight out of every 10 consumers are generally unaware of how to access medical care via telehealth, or that their insurer will cover the cost.

APPLE PLANS TO RELEASE A SOFT-ware update for the iPhone in March that will let users view their health records.

The addition to the iPhone's Health app, which contains a variety of health- and fitness-based services, would amplify the health records feature and enable users to pull up their medical history, such as past procedures and lab results.

Apple has partnered with 12 healthcare organizations on the feature, including Johns Hopkins Medicine, Cedars-Sinai and Penn Medicine, the company said.

"The updated Health Records section within the Health app brings together hospitals, clinics and the existing Health app to make it easy for consumers to see their available medical data from multiple providers whenever they choose," the announcement noted. The 12 participating hospitals "are among the first to make this beta feature available to their patients."

The approach will use standards-based technology to bring records information to the phone, Apple indicated, saying it worked with the healthcare community to take a consumer-friendly approach, creating Health Records based on the emerging Fast Healthcare Interoperability Resources (FHIR) standard, which enables the exchange of information in electronic medical records.

Health records data is encrypted and protected with the user's iPhone passcode.

"We've worked closely with the health community to create an experience everyone has wanted for years—to view medical records easily and securely right on your iPhone," said Jeff Williams, Apple's COO. "By empowering customers to see their overall health, we hope to help consumers better understand their health and help them lead healthier lives."

—*Fred Bazzoli*

Industry Groups Aim to Speed Prior Authorization Process

NATIONAL ELECTRONIC STAN-dards are expected to play a key role in an industrywide effort to streamline the process of communicating prior authorizations for treatment.

Groups representing hospitals, physicians, medical groups, health insurers and pharmacists have announced a joint effort to facilitate the often lengthy insurance approval process called prior authorization—also known as pre-approvals—that slow delivery of treatment to patients.

The collaboration includes the American Hospital Association, America's Health Insurance Plans, American Medical Association, American Pharmacists Association, Blue Cross Blue Shield Association and Medical Group Management Association.

Facilitating the prior authorization process also is expected to provide benefits to the healthcare industry, participants in the initiative say—it could reduce administrative burdens for healthcare professionals, hospitals and health insurers.

Typically, if a treatment or prescription requires prior authorization, it must be approved by a health insurer before it's administered. These approvals can be burdensome for all parties because the processes vary and often are repetitive. Streamlining can reduce the number of steps and time delays.

The groups have signed a consensus statement, pledging to work together on a variety of initiatives. In particular, they are committing to accelerating industry adoption of national electronic standards for prior authorization and improving transparency of formulary information and coverage restrictions at the point of care.

The organizations say they will seek to improve communication between health insurers, healthcare professionals and patients to minimize delays in care and ensure clarity on prior authorization requirements, rationale and changes.

—*F.B.*

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SHIEC Launches Patient Centered Data Home Initiative Nationally

Docs Hit by Breach Incidents

The vast majority of U.S. physicians say their practices have experienced a cybersecurity incident, as the American Medical Association said the healthcare sector needs to increase cybersecurity support for medical practices. A survey of 1,300 physicians found that 83 percent of respondents have experienced a cyberattack, and 74 percent say they're most concerned that future attacks could interrupt their ability to deliver care in their practices, while a similar percent say it could compromise the security of patient records. Some 53 percent say future attacks could jeopardize patient safety. The research was released by the AMA and Accenture.

THE STRATEGIC HEALTH INFORMation Exchange Collaborative, representing HIEs across the country, is launching nationally its Patient Centered Data Home initiative, a secure data exchange system that alerts providers when their patients have a healthcare event beyond where they typically receive care.

Under the PCDH initiative, HIEs are automatically able to notify each other regarding the existence of a patient's medical records and to synchronize their identity among participating HIE systems, providing a nationwide network for securely sharing patient information when and where it is needed.

Dan Porreca, chair of SHIEC's board of directors and executive director for HEALTHeLINK, says the initiative has been in the works for about two years and that the national launch of PCDH is the result of three smaller regional implementations—central, heartland and western—in which 17 HIEs collaborated to prove the concept of inter-HIE information sharing and notification.

"The HIEs working together to create PCDH built a powerful foundation for interoperability between HIEs—and we managed to do it using our current technologies," Porreca says. "We also created and agreed to a national, legally binding agreement, which laid the foundation for HIEs sharing data with each other across state lines and throughout communities."

PCDH makes it possible to achieve health episode notification and efficient data sharing across the country, according to SHIEC. When a patient is treated at a medical facility away from home generating an Admission-Discharge-Transfer message, PCDH leverages ZIP code information in the ADT to automatically detect that the patient is receiving treatment outside the home area, explains Porreca.

"It's about leveraging tools and technologies the HIEs already have," he adds.

—Greg Slabodkin

CDC Combats Opioid Crisis With Health, Prescription Data

THE CENTERS FOR DISEASE AND Prevention is trying to help stem the tide of opioid overdoses nationwide through its public health data collection and reporting, as well as improvements to state-run electronic databases for tracking prescriptions.

CDC is "funding an opioid surveillance program collecting timely data on both fatal and non-fatal overdoses so we can pinpoint resources and responses where needed most," Debra Houry, MD, director of the CDC's National Center for Injury Prevention and Control, told a Senate appropriations subcommittee.

According to Houry, CDC "has been on the front lines" of the crisis

ever since it first identified the increase in opioid overdose deaths in 2004, and "since then, the agency has applied its scientific expertise to track the epidemic and develop evidence-based prevention strategies." Nonetheless, she acknowledged that the opioid epidemic is "one of the few public health problems that is getting worse instead of better," with drug overdoses nearly tripling over the past two decades.

Still, Houry testified that the CDC's Enhanced State Opioid Overdose Surveillance (ESOOS) is leveraging emergency department and emergency medical services data to better track and analyze morbidity

data. She told lawmakers that the agency is improving public health data collection and reporting to better understand the opioid crisis.

"We have improved reporting of overdose deaths from a lag of two years to seven months," Houry testified. "As part of CDC's funding to states, we've implemented a program to get more reliable and timely data from emergency rooms, medical examiners and coroners."

She noted that the CDC funds 45 states and Washington, DC, to implement strategies to prevent opioid overdoses and improve state-run prescription drug monitoring programs.

—G.S.

DoD Aims to Expand Use of Telehealth

The Department of Defense is expanding its ability to deliver telehealth services to active duty military personnel, veterans and their families by designating a provider of telemedicine services to operate on its networks.

The agency has issued an Authority to Operate (ATO) to GlobalMed, an international provider of telehealth services, thus enabling the company to put its virtual health applications, hardware and software directly on the DoD networks.

The vendor says the authorization will make their solutions available to the Military Health System, the DoD's integrated healthcare system.

ONC Issues Interoperability Draft

The Office of the National Coordinator for Health IT has released a draft Trusted Exchange Framework to enable interoperability across disparate healthcare information networks nationally, as directed by the 21st Century Cures Act.

The draft framework is designed to support nationwide interoperability by outlining a common set of principles, as well as minimum terms and conditions for trusted data exchange. According to ONC, the document focuses on policies, procedures and technical standards that build from existing health information network capabilities and enables them to work together to provide a "single on-ramp" to patient information regardless of the HIT vendor they use or the health information exchange (HIE) with which they contract.

"Currently, there are more than 100 regional HIEs and multiple national level organizations that support exchange use cases," states ONC's draft Trusted Exchange Framework. "While these organizations have expanded interoperability within their particular spheres, the connectivity across all or even most of them has not been achieved. This has limited the patient health information that a provider or health system has access to, unless they join multiple networks."

According to ONC, the proposed Trusted Exchange Framework supports the agency's goals of achieving nationwide interoperability by—among other capabilities—having "open and accessible application programming interfaces (APIs) to encourage entrepreneurial, user-focused innovation to make health information more accessible and to improve electronic health record (EHR) usability."

National Coordinator for HIT Donald Rucker says provisions of the Cures Act seek to advance the interoperable exchange of electronic health information, and the agency's draft Trusted Exchange Framework will help guide the country toward interoperability.

—Gregory Slabodkin

Net Neutrality Demise Worries Providers

IN A STRICT PARTY LINE VOTE, THE FEDERAL Communications Commission chose to roll back regulations that uphold net neutrality. Some healthcare organizations are concerned that the move could have downstream implications for providers, particularly those located in and serving rural areas.

The five-member FCC voted 3-2 along party lines to eliminate its 2015 Title II Order that requires net neutrality, the principle that Internet service providers must allow equal access to web content, regardless of the source. Proponents of removing the rules contend that the move will unfetter competition and thus boost economic growth.

However, critics—among them hospital organizations—contend that the move will set the stage for cable TV-like tiers of services that would force consumers to pay more for services. This may be particularly true in rural areas, where there is often little or no competition among Internet service providers.

Some say the FCC vote could prompt federal legislative action to reinstitute net equality, and New York State Attorney General Eric T. Schneiderman issued a statement saying his office will take legal action to block the rollback of net neutrality regulations.

Ajit Pai, the FCC chairman appointed by President Trump, has framed the repeal as getting the government to "stop micromanaging the Internet" and has stated that the move could benefit technology companies and could encourage technologies that support telemedicine and add bandwidth to underserved areas, enabling hospitals to have "fast lanes" of service that could improve Internet speeds.

However, many healthcare organizations have long opposed the removal of net neutrality regulations and voiced concern over the impact of the FCC vote.

The National Rural Health Association has long opposed the rollback of net neutrality provisions, fearing that the elimination of the rules could have negative effects on bandwidth for rural healthcare facilities, and will hurt efforts to provide telemedicine and telehealth services to residents in their service areas.

"NRHA supports broadband policies that acknowledge high-speed online access as a necessity, not a luxury. All communities deserve a chance to participate in our digital future," the group affirmed.

Potential negative effects on Internet services comes at the wrong time for rural areas, where residents are victims disproportionately of deaths from certain chronic diseases and opioid addiction, says Tom Morris, associate administrator for rural health at the Health Resources and Services Administration.

—*Fred Bazzoli*

CMS bans texting by doctors

The Centers for Medicare & Medicaid Services has outlined a position that the texting of medical orders by physicians is not permissible.
The position was outlined in a memo to state survey agency directors from the head of CMS' Center for Clinical Standards and Quality/Survey and Certification Group.
The guidance from CMS states that the texting of patient orders "is prohibited regardless of the platform utilized," and computerized provider order entry (CPOE) "is the preferred method of order entry by a provider."
The document does allow texting of patient information among members of a healthcare team

Pew, AMIA Protest Cuts in ONC's FY18 Budget

FULL IMPLEMENTATION OF THE 21ST CENTURY Cures Act to accelerate medical breakthroughs could be in jeopardy if proposed budget cuts to the Office of the National Coordinator for Health Information Technology are not restored, according to the Pew Charitable Trusts and the American Medical Informatics Association.

A letter from the organizations to four congressional leaders warns that proposed budget cuts planned for ONC will hamper its efforts to implement the Cures Act.

The House of Representatives budget proposal calls for a $38.3 million budget for ONC in Fiscal Year 2018, down from $60.3 million in FY 2017, and the Senate proposal calls for a continuation budget next year of $60.3 million, said the letter, signed by Ben Moscovitch, manager of health information technology at Pew and Jeffery Smith, vice president for public policy at AMIA.

The letter was addressed to Senators Roy Blunt (R-Mo.) and Patty Murray (D-Wash.), and Representatives Tom Cole (R-Okla.) and Rosa DeLauro (D-Conn.), who all hold powerful positions overseeing Labor, Health and Human Services and Education budgets.

Recent testimony from ONC Deputy National Coordinator Jon White indicated that the agency would not be able to fully fund bipartisan provisions in the Cures Act, including initiatives to improve the transparency, interoperability and usability of electronic health records, Moscovitch and Smith note in their joint letter.

However, efforts are ongoing to educate lawmakers on the frustrations physicians face when working with EHRs, Moscovitch says. The challenges of interoperability and usability can bring safety concerns, he notes.

—*Joseph Goedert*

ARTIFICIAL INTELLIGENCE
REAL RESULTS

Pioneer healthcare organizations see benefits from AI.

By Linda Wilson

Artificial intelligence—a broad set of technologies that enable machines to mimic the human brain's ability to process information, learn and adapt—holds potential in healthcare to improve patient outcomes and reduce costs, but it hasn't yet been widely adopted in daily clinical practice.

However, some leading healthcare organizations, such as the Cleveland Clinic, Intermountain Healthcare and others, are beginning to build the infrastructure and data science capabilities to use AI to deliver clinical and financial benefits.

While some industries are using AI programs designed to recognize speech, written language or visual data or do problem-solving, health systems are gaining experience with machine learning, a subset of AI focused on finding patterns or relationships in data in an iterative, or learning, fashion. Early projects have demonstrated promising results.

In some of these cases, healthcare organizations have purchased a commercial tool to help them reach a specific clinical goal, such as reducing hospital readmission rates or predicting which patients are at highest risk of becoming expensive cases. The work often incorporates machine learning techniques to hone existing models or clinical processes, with the aim of improving accuracy.

Betting on the future

The potential for AI to uncover actionable insights from electronic patient data has convinced venture capitalists and software developers alike to invest in the healthcare arena. In a 2016 report, Frost & Sullivan predicted that the revenues in the healthcare AI marketplace will explode from $633.8 million in 2014 to nearly $6.7 billion in 2021.

The Cleveland Clinic is one health system actively working with machine learning.

It spent more than three years building an infrastructure to support advanced analytics. The technology platform includes both a structured database environment using Teradata and a Hadoop database environment using Cloudera. The health system uses analytics tools from SAS and supports open-source programming languages, such as Python and R.

"We also recognize that we are not always going to be starting from scratch," says Christopher Donovan, executive director of enterprise information management and analytics in the division of finance and information technology at the Cleveland Clinic. "We also think about how we are going to engage with partners in the system."

For example, the Cleveland Clinic developed a test for IBM's Watson Health cognitive platform to see if Watson could create a problem list based on the information—both structured and unstructured—in a patient's electronic health record. Using de-identified data, "they were able to get some good results with it generating a problem list," Donovan says. The next step is to figure out how to take that work beyond the research phase and apply it to clinical decision support, he adds.

The Cleveland Clinic also has used machine learning to develop applications from scratch, such as a set of tools to identify patients at risk of racking up big medical bills.

For the first step, they used a variety of mathematical methods—neural networks, decision trees and gradient boosting—to develop algorithms that rank the patients

Working with artificial intelligence at the Cleveland Clinic, from left: Christopher Donovan, executive director of enterprise information management and analytics; Joe Dorocak, senior financial analyst; Michael Lewis, senior director of healthcare analytics.

assigned to care coordinators. The scores, which are updated monthly, augment existing registries to help care coordinators decide how to manage their caseloads.

The team also developed algorithms to identify patients who are not enrolled in the care coordination program but are at risk of becoming high-cost cases in the future. However, that tool has not yet been incorporated into the clinical workflow, an essential step to enable case managers to intervene. "We might be interacting with those patients a little differently," says Joseph Dorocak, senior financial analyst at the Cleveland Clinic.

At Ohio State University Wexner Medical Center, researchers in the radiology informatics lab also are using machine learning to build tools that help clinicians manage their workloads. For example, they developed an algorithm that prioritizes computed tomography images of the head based on whether there are critical findings.

Radiologists learn of the potential seriousness of a given imaging study when a referring clinician labels it as *stat*, explains Luciano Prevedello, MD, division chief in medical imaging informatics, adding that this is not an ideal system for prioritizing workflow in radiology. Sometimes images

show critical findings the ordering physicians didn't anticipate, he says. And even studies labeled *stat*—about 40 percent of all studies—vary in degree of urgency.

To build the tool, researchers trained an algorithm using a data set of 2,583 head images and validated the tool with a second set of 100 head images. The next step is to set up a clinical trial. "This is an important step to see if what we developed in the lab can be expanded to a clinical setting," Prevedello says.

Commercial solutions

Instead of starting from scratch, Intermountain Healthcare has purchased com-

mercial products to help improve its clinical processes and patient outcomes.

For example, Intermountain—which has 22 hospitals, 1,400 employed physicians and more than 185 clinics—began working with Ayasdi, an AI vendor in Menlo Park, Calif., in 2014.

"The first thing we did was try to validate that [the Ayasdi solution] would work on our data," says Lonny Northrup, senior medical informaticist at Intermountain. To do this, the provider fed data on colon surgery into the tool. Colon surgery was selected because the health system had an established clinical care pathway for the procedure.

"In a matter of two or three days, it cranked through the data," Northrup says, adding that the tool replicated "a substantial portion of what we have done over eight years in the insights it was able to derive from the data."

Since then, Intermountain has used Ayasdi's tool to refine other care pathways. For example, Intermountain plans to roll out a revised care pathway this year for treating newborns with high fevers. Northrup predicts that the changes, which he declined to discuss in detail, will reduce the average length of stay and impact thousands of babies throughout the health system.

Intermountain also plans to use the tool to track how well physicians are adhering to about 70 care pathways the healthcare organization has developed. "It has the ability to do that with more granularity than we can get with our other solutions," Northrup says. "If we are not getting the adherence we want, we will have the data to show the underperforming physicians how the better-performing physicians are getting better results by following the care model."

Intermountain has been working with other machine learning vendors as well. For example, Intermountain in 2016 became a lead investor in Zebra Medical Vision, a machine-learning analytics imaging company. In 2017, Intermountain, which has a library of more than 3 billion

medical images, announced plans to deploy Zebra's technology to help Intermountain's radiologists diagnose diseases.

Intermountain also is evaluating a tool from Jvion, Johns Creek, Ga., to create personalized health risk profiles for individual patients and recommendations about how to lower their risk for deteriorating health. "Our initial validation of their platform is around avoidable admissions, and the findings we are generating are extremely encouraging," Northrup says.

Assisting ER cases

Like Intermountain and the Cleveland Clinic, MedStar Health, which operates 10 hospitals in Maryland and the Washington metropolitan area, also is evaluating the applicability of AI to solve clinical problems.

MedStar's Institute for Innovation worked with Booz Allen Hamilton to develop a tool for emergency department clinicians. The tool, called Dictation Lens, uses natural language processing to sort through unstructured electronic patient data, such as clinicians' notes, and pull out those that are relevant to a patient's current medical complaint.

"On average, MedStar patients have 50 to 60 notes in their history," which is too many for an ED physician to sort through manually, says Ernest Sohn, a chief data scientist at Booz Allen.

A handful of ED physicians at MedStar tested the tool last year. Based on feedback from those physicians, the MedStar/Booz Allen team plans to refine the tool this year and then retest it.

The prototype took between 10 and 20 seconds to present pertinent notes to ED clinicians, which is too slow, says Kevin Maloy, MD, an emergency department physician and informaticist with Med-

Star's Institute for Innovation. To solve the problem, they plan to change the back-end data processing so it begins culling through clinicians' notes when a patient registers in the ED, ensuring that the information will be available to clinicians when they open a patient's record, Maloy says.

Citing Dictation Lens as an example, Sohn, Maloy and other authors of a 2017 blog post in *Health Affairs*, wrote about machine learning's potential to perform mundane and time-intensive tasks for physicians. "By draining time, energy and attention, such tasks can lead to clinician burnout and hinder clinicians' ability to practice at the top of their expertise when providing care," they wrote.

Overcoming challenges

However, there are significant barriers to widespread adoption of machine learning and other AI technologies in healthcare to perform mundane tasks, organize workflow, diagnose disease, predict outcomes, or prescribe treatments or behavior changes. This is particularly true for smaller organizations because they have fewer financial, technical and intellectual resources than large health systems or academic medical centers.

When it comes to financial considerations, AI adoption competes with other pressing issues in health information technology, according to a survey of health system executives conducted by the Center for Connected Medicine at the University of Pittsburgh Medical Center and The Health Management Academy, Alexandria, Va.

Of the 20 respondents to the survey, "Top of Mind for Top U.S. Health Systems 2018," 63 percent said investing in AI solutions would be a low priority in 2018, compared with spending in other areas, such

> # "We are not always going to be starting from scratch."
>
> ## —Christopher Donovan

as cybersecurity or virtual care. Those health systems plan to spend an average of 2.6 percent of their IT budget on AI in 2018, and 13 percent plan to spend no money on AI in 2018.

Where they have implemented AI solutions in previous years, it was typically in operational areas, such as revenue cycle management, survey findings revealed.

In addition to budgetary constraints, there are technical hurdles to overcome. Chief among these is access to large, vetted data sets, so that machine learning algorithms can be "trained" to recognize the correct answer to a given problem, such as which images show cancerous tumors. Researchers also need access to a second data set to validate an algorithm's performance, says Paul Chang, MD, professor and vice chairman of radiology informatics at the University of Chicago School of Medicine.

Another issue is the underlying IT infrastructure. "Our IT systems are immature in healthcare," Chang says. "We can't get vetted data."

Pertinent data is stored in disparate systems, such as numerous inpatient and outpatient EHR systems; ancillary systems for radiology, pharmacy or other departments; billing systems; and patient-generated data from social media sites, monitors or wearable devices. Because of variation in databases and data types, it's difficult to get that together to enable AI solutions to draw conclusions.

Even within a single system, such as an EHR, data on clinical outcomes often is difficult to find because it is not captured in a standardized way. In their blog post, Sohn and Maloy wrote that pain scores were captured "incompletely and inconsistently" in MedStar's EHR, which made it difficult for them to build a model to predict patients' pain scores.

After an algorithm is built and deployed into workflows, sophisticated data governance also is needed to maintain both data sets and algorithms over time. For example, the Cleveland Clinic's risk

AI efforts are still early, 'not at the solution level'

While there has been a lot of publicity about the potential of AI in radiology to recognize images and, when paired with algorithms, assist in the diagnosis of diseases, this work remains in the research realm.

"We are not at the solution level yet," says Paul Chang, MD, professor and vice chairman of radiology informatics at the University of Chicago School of Medicine. "It is a long way between initial promising results in the lab and true clinically validated solutions."

And despite the implementations of machine-learning assisted algorithms for specific use cases in clinical operations, there are many stumbling blocks to widespread adoption of machine learning and other AI technologies. There are competing priorities for spending IT budgets and myriad technical issues, such as the lack of reliable large data sets, sophisticated data management or workflows that can incorporate new insights.

Nonetheless, health system executives believe the knowledge generated from AI tools will help their organizations remain financially viable as they assume financial risk for clinical outcomes. Machine learning, for example, can help derive predictive and prescriptive information from data, which then can be embedded into electronic health records, so that the insights are readily available to clinicians as they interact with patients.

"The real bottom-line benefit of this technology is understanding the business of medicine, so I can actually become more efficient, and reduce error and reduce variability," Chang explains.

Using AI to draw conclusions from medical information, such as that contained in electronic medical records—say, as a clinician would—is more complex and much farther out on the horizon, says Luciano Prevedello, MD, division chief in medical imaging informatics at Ohio State University Wexner Medical Center.

"I can develop an algorithm that helps me detect whether there is blood in the brain or not—that is very doable," he says. "But to get to the reason this patient is developing the hemorrhage? That is a different question and a different level of complexity."

predictor is an automated process that runs data through numerous mathematical models each time the process kicks off, and then automatically generates results from the model that gives the most accurate predictions that day.

IT staff members at the Cleveland Clinic built the automated process to prevent model degradation over time. If one of the mathematical models falls below acceptable levels of performance consistently, "the goal would be to reevaluate that specific model on its own; tweak it; fine tune it as needed; and enter it back into the process," says Michael Lewis, senior director of healthcare analytics.

Workflow constraints

Even after solving the myriad data extraction, model validation, data governance and other technical issues, healthcare organizations may need to develop new workflows to respond to the knowledge generated by these advanced analytical tools.

That is the case at Memorial Sloan Kettering Cancer Center, where data scientists have developed a model to predict which chemotherapy patients are at risk of showing up at the health system's urgent care center and possibly being admitted to an inpatient unit.

Now, the healthcare system is mapping out new processes—including the use of telemedicine and ongoing patient engagement—to mitigate patients' risk of going to the urgent care center. "There is a heavy lift. It is an ambitious use case," says Stuart Gardos, chief data officer at Memorial Sloan Kettering.

The Cleveland Clinic's Donovan urges CIOs to help build an organizational culture in which people are willing to incorporate new insights into their daily work and decision-making processes. "AI and machine learning are big buzzwords and people are saying, 'We really need to use this,'" he says. "We need to not only produce this stuff, but we need to be able to use it—to make decisions with it." ∎

ANATOMY OF AN ATTACK

Hospital's response to ransomware provides valuable lessons.

By Greg Slabodkin

It was a Sunday morning like any other in the emergency department of Erie County Medical Center, a 602-bed hospital in Buffalo, N.Y., and the Western New York area's Level 1 trauma center.

However, around 2 a.m. on April 9, 2017—Palm Sunday—a member of ECMC's clinical staff was the first to see an electronic ransom note on a workstation. "You must send us 1.7 BitCoin for each affected PC OR 24 BitCoins to receive ALL Private Keys for ALL affected PC's," read the note from the cybercriminals, demanding the equivalent of $44,000 in bitcoin cryptocurrency in return for a key to unlock the hospital's files.

No one "really expects something like this to happen to them and their hospital," says Jennifer Pugh, MD, ECMC's associate chief of emergency medicine, who was in the ER when the ransomware hit. She credits the quick response of the medical staff with enabling ECMC to manage the crisis.

As the day went on, the hospital found itself enmeshed in a major ransomware attack.

Ransomware, used by hackers to target all kinds of organizations worldwide, is a type of malicious software surreptitiously installed on a computer that encrypts files and then holds the data hostage in return for payment of a ransom. After a computer's hard drive is encrypted, a ransom note typically appears on the user's screen, demanding payment for a software "key," similar to a password, which unencrypts the hard drive.

ECMC responded quickly to the attack, following a pre-arranged script. To prevent the rampant spread of the ransomware, the organization purposely shut down its information systems, including an electronic health records system, email and website—among others.

The staff recognized the threat almost immediately and within minutes notified security executives—who limited the spread of the malware—called in experts to deal with the crisis and, soon after, employed a novel workaround for accessing patient data.

Ultimately, more than 6,000 of ECMC's computers were infected by a common version of ransomware called SamSam. To recover, the hospital would need to meticulously clean the file-encrypting malware from the hard drive of each computer that was hit.

ECMC says patient records were never compromised during the incident. Even so, the incident took six weeks to resolve and cost millions of dollars to fix. Perpetrators of the attack have not been caught.

The hospital's experience is a cautionary tale for other healthcare organizations, which are regularly targeted by ransomware attacks and may fall victim to similar incidents. The number of reported major ransomware events targeted against healthcare organizations increased from 19 reported in 2016 to 36 reported in 2017—an 89 percent increase in the frequency of ransomware attacks—according to cybersecurity vendor Cryptonite.

"What the ransomware attack at ECMC proved is that every organization has potential vulnerabilities," says Peter Cutler, ECMC's vice president of communications

and external affairs. "What is important to emphasize and proved critical in the ECMC attack is quick detection of an attack and immediately taking appropriate steps to prevent widespread damage to an organization's computer infrastructure."

Despite its success in dealing with the attack, ECMC has been cautious in releasing information about the incident—which is not atypical for organizations hit with ransomware, according to Adam Cohen, special agent in charge of the FBI's Buffalo Field Office. Cohen, who declined to either confirm or deny an FBI investigation of ECMC's attack, notes that often victims of ransomware keep the details confidential because of concerns over privacy, business reputation or regulatory data breach reporting requirements.

While ECMC released some statements to the press from its executives during and

after the crisis, the hospital declined multiple requests from *Health Data Management* to interview IT staff and executives about the incident. It did, however, grant interviews with Pugh, its associate chief of emergency medicine, and Reg Harnish, CEO of GreyCastle Security, the cybersecurity firm that managed ECMC's response to the event.

Attack timeline

The Sunday morning of the attack, a member of ECMC's clinical staff was the first to see the ransom note on a workstation. Alarmed by the message, the clinician, following ECMC's protocol, immediately called the facility's helpdesk, which in turn notified the medical center's chief information security officer.

In response, ECMC executives made the decision by 3:30 a.m. to shut down all

IT systems—including a Meditech electronic health record system, email and website—in an attempt to stop the ransomware from spreading throughout the organization.

With the EHR out of commission, Pugh says, the hospital executed an existing contingency plan and reverted to using paper-based charts and face-to-face communication. "We do practice this and prepare for it," she adds. "It involves going to paper records and paper order forms."

Shortly before 5 a.m., ECMC reached out for help to GreyCastle Security, a cybersecurity firm in Troy, N.Y., which operates a 24/7 emergency response hotline, to head up remediation efforts. Within 15 minutes of that call, Harnish says his company was involved in triage to contain the incident; he activated a six-member response team, who went from Troy to

Buffalo to manage the crisis onsite.

"That Sunday morning, when we began triage, cybercriminals were still accessing [the ECMC] network," Harnish says.

Despite that access, medical records weren't compromised and patient care was not negatively impacted, hospital executives said in public statements. At no point during the incident did ECMC consider paying the $44,000 ransom demanded by hackers, Harnish adds. "Our advice [to ECMC] never changed, and it never changes with anyone, which is not to pay the ransom," he says. "The reality is that even if you pay the ransom, there's no guarantee that it's actually going to work."

Likewise, the FBI doesn't support paying to resolve a ransomware attack, says Cohen. Rather, the agency urges prevention as a first step and regular data backups to recover in the event of an attack, with recovery data stored on media that's not connected to the network.

While ECMC had regularly backed up data in multiple ways before the ransomware attack, the hackers "looked for and deleted all of those backup files that were online," thus complicating the recovery process, Harnish says. As a result, the hospital "had to resort to older backups that were offline and not connected to the network," he adds.

Justin Armstrong, a security analyst for Meditech, contends that backing up data regularly and verifying the integrity of those backups is critical to getting EHR systems back after an attack.

"Whether to pay [the ransom] or not is a very individual thing," ECMC President and CEO Thomas Quatroche told *The Buffalo News*. "If you have no backup, you have no choice." By backing up its data, the hospital ensured that it did not have to give in to the ransom demand from hackers.

Restorations and workarounds

In the hours, days and weeks after the attack, ECMC made steady progress in restoring its computer systems through a multiphased approach.

With its EHR system down, ECMC turned to HEALTHeLINK, a regional health information exchange in Western New York. HEALTHeLINK provided critical access to some patient records for ECMC clinicians immediately after the attack. "That became a bit of a lifeline," Harnish says of HEALTHeLINK, a collaborative effort started in 2006 by healthcare organizations in the Western New York area to share clinical information and make patient records available.

In working around the ransomware attack, HEALTHeLINK served as a source of data backup with the information safely stored in the cloud. ECMC was one of the first participants in the HIE and "has been very progressive" in its participation, according to HEALTHeLINK Executive Director Daniel Porreca, even building an interface to HEALTHeLINK into its Meditech EHR.

"We had invested a lot of time and money to upload all of ECMC's prior records into HEALTHeLINK—literally, up to the moment our computer systems were intentionally shut down in the aftermath of the attack," says Pugh. "We were able to go and look up prior patient records, surgical reports, CT scans, labs—everything that we would normally get out of our computer screens."

While ECMC used paper records in the first hours of the system shutdown, HEALTHeLINK helped ECMC implement an EHR workaround that enabled hospital staff to use laptops with ad hoc Internet access to view patient records through a web-based portal that accessed the HIE's database.

"Very quickly, we had one of our staff on

a call to reset passwords to enable access, and by early Sunday afternoon, we had one of our staff in the hospital working directly with providers as they set up laptops to get Internet access," says Porreca. "By Monday morning, we had seven people onsite working in the areas where the laptops were being deployed and getting access to [ECMC] data via HEALTHeLINK.

"Based on their involvement with us, ECMC was able to continue clinical operations almost immediately and to access their own data by using HEALTHeLINK,"

"The attack proved that every organization has potential vulnerabilities."
—Peter Cutler

he adds. "We were fortunate to be in a position where we could help."

"Any hospital that has the ability to participate in a health information exchange such as HEALTHeLINK should do so—it was that important to us," contends Pugh. "I don't think our patients even noticed because we really tried to provide the same level of care, even without use of our EHR."

Still, some processes, such as placing orders or detailing care plans, required the use of paper and pen, Pugh says. For some clinicians, there were benefits to going back to these old practices, such as spending more face time with patients and less time in front of a computer screen. At the same time, Pugh notes that for some of the hospital's younger staff and medical students a paper-based process took some getting used to because they hadn't practiced in an environment without computers before. "We spent a lot of time with our residents making sure they knew how to appropriately document patient charts without EHR prompts," she adds.

Other processes were moved off-screen as well. For example, clinicians normally would look at X-rays or CT scans on a computer screen, but now temporarily they

had to view them directly on film or at the CT scanners, Pugh says.

To enable physicians to place medical orders, ECMC printed out paper versions of the forms that had to be signed with a pen instead of being initialized on screen. Electronic prescribing—which New York State mandated in 2016—was a bit challenging in the aftermath of the ransomware attack, Pugh notes, but physicians used paper prescription pads to place orders, and "all the local pharmacies were notified of our issues."

According to Michael Vinson, manager of client support and a member of Meditech's disaster recovery application team, ECMC has been an EHR customer since the late 1990s. In addition to the EHR system being down, he recounts that early in the aftermath of the ransomware attack, one of the big challenges in assisting ECMC remotely was that the hospital didn't have an operating email system and could only communicate through "old school" phone and text messages.

Further recovery efforts

By April 21—12 days after the initial attack—the hospital website had been restored, temporary email was established, some financial systems began to come online, and more than 6,000 hard drives had been cleaned and returned to workstations. In addition, ECMC's EHR system from Meditech was available to staff clinicians, but just in view-only mode.

During the week of April 24, the medical center installed a new hospital email system, continued the phased restoration of inpatient EHR-related functions and began to roll out restored desktop computers. And by the week of May 1, ECMC started electronic transmission of radiological images as well as physician documentation, beginning with the emergency and psychiatric emergency departments, while continuing the rollout of restored desktop computers and the restoration of inpatient EHR functions.

The quick recovery was enabled by prior staff training, planning and quick response of ECMC staff to the breach, limiting the damage to its systems while ensuring patient safety. However, ECMC's recovery carried a huge financial cost. This past summer, the hospital initially reported a $10 million price tag for repairing the damage and restoring its information systems.More recently, an ECMC spokesman reported the final cost of rebuilding the hospital's computer systems is "not yet finalized."

But fortuitously, the hospital in late 2016 increased its cyber insurance coverage to $10 million from $2 million, increasing its financial protection against such cybersecurity events, ECMC's CEO Quatroche told *The Buffalo News.*

Rising threats, old vulnerabilities

ECMC's experience is emblematic of the challenges of overcoming ransomware attacks, which are on the rise. Results from a survey conducted by HIMSS Analytics, released in December 2017, show that 78 percent of providers have experienced a ransomware or malware attack in the past 12 months.

"It's something that affects the single, sole practice medical professional all the way up to major hospitals," says FBI special agent Cohen, who believes the trend will continue to rise with "more incidents of ransomware, hacking and intrusions."

The FBI has warned that in newer instances of ransomware, cybercriminals are increasingly capitalizing on unpatched software on end-user computers. For example, in May 2017, hundreds of thousands of computers worldwide were compromised by the WannaCry ransomware in at least 150 countries, including the National Health Service in the United Kingdom, where the cyberattack froze computers at hospitals and closed emergency rooms. WannaCry affected systems that did not have the latest security patches and were running older versions of the Windows operating system that are no longer supported by Microsoft.

WannaCry is not the only variant of ransomware being used to attack healthcare providers' systems. According to GreyCastle's Harnish, the SamSam ransomware that hit ECMC targets web server vulnerabilities to infiltrate computer networks, which is how he believes ECMC's systems were hacked.

"It was a single technical vulnerability," says Harnish. "It was a very common but very simple vulnerability—by simple, I mean one that is easily addressed and fixed."

An alert from the FBI details that SamSam uses an automated script that crawls the Internet looking for server vulnerabilities involving JBoss (an open source application server program from Red Hat) and Remote Desktop Protocol (or RDP, a Microsoft remote management tool), exploiting either weak passwords or cracking default passwords with brute force attacks. Once it finds one, the script exploits the vulnerability—known as "patient zero"—and then gains access to the victim's network.

For ECMC, the "patient-zero vulnerability was a default password on an Internet-facing asset," Harnish believes. "It was what ended up being the initial vulnerability that was exploited and gave those criminals access."

According to Harnish, the SamSam ransomware attack on ECMC did not involve

"It affects the sole practice medical professional up to major hospitals."
—Adam Cohen

a JBoss server, leaving the other possibility—an RDP vulnerability. "I can't confirm or disconfirm that," he adds.

Avi Rubin, director of the health and medical security lab at Johns Hopkins University, says a common technique hackers employ is scanning the Internet for computers that have insecure connections—called ports—and exploiting vulnerable applications such as RDP.

"Once the attackers gain a foothold in this manner, they can attack the passwords in the system by using sophisticated dictionaries and matching techniques to crack the passwords in the system," notes Rubin.

Phillip Hallam-Baker, principal scientist and vice president at cybersecurity vendor Comodo, warns that if the password is a default password, the attacker already knows it.

"Quite often, software ships with an account 'guest' with password 'password,'" remarks Hallam-Baker. "In the past, software often shipped with admin accounts with default passwords, but that happens much less now because it is flagged as an issue."

In 2016, the FBI issued a warning about SamSam ransomware, detailing how cybercriminals were exploiting such vulnerabilities, particularly in the healthcare industry.

Nonetheless, Cutler, ECMC's vice president of communications and external affairs, is dismissive of any fault or negligence on the part of the hospital. "Organizations across the country routinely receive information of cyberattack warnings from entities like the FBI," Cutler says.

"When you have an environment [like ECMC] where there are 6,000-plus computers, the likelihood that the configuration on one of the computers was incorrect is pretty high," contends Harnish.

Similarly, Meditech's Armstrong says that, in a big complex computing environment like a hospital, "there's always going to be something that has a vulnerability"

that is going to put any devices that connect to the Internet at risk.

Resilience in facing ransomware

While there are other variants of ransomware, Harnish says SamSam is "rampant" in healthcare and will continue to pose a cybersecurity threat to hospitals—though he would not reveal who was behind the ECMC attack or their country of origin. Based on his experience, FBI Special Agent Cohen says most of the ransomware attacks being launched on the U.S. are initiated in Eastern Europe.

"What's happening is a form of terrorism like an attack on critical infrastructure," ECMC's Quatroche told *The Buffalo News.*

Harnish believes that most medical facilities are woefully unprepared for the kind of attack that hit ECMC, arguing that it's not a question of if—but when—the next health system will fall victim to malware.

The FBI's Cohen urges victims of ransomware to report incidents to the agency—regardless of the outcome—to help it gain a more comprehensive view of the current threat environment. "Our job is to help, however we can, and the more that we know about the types of attacks and the tactics used enables us to better understand the threat."

To facilitate public-private collaboration between U.S. businesses and the FBI, InfraGard was established as a not-for-profit organization to expedite the timely exchange of information and promote mutual learning opportunities when it comes to cybersecurity. "That's our way to not just take information but provide information back," says Cohen.

For its part, the FBI suggests organizations focus on two main areas: prevention in terms of both awareness training for employees and robust technical prevention controls, as well as the creation of a solid business continuity plan in the event of a ransomware attack.

Healthcare organizations "need to build a response capability—this is about resil-

ience in healthcare," says Harnish.

Resilience is clearly a message that resonates with the industry. As results of the HIMSS Analytics survey released in December 2017 showed, 97 percent of providers have a high level of concern about cybersecurity and resilience—defined as an organization's capacity to adapt and respond to adverse cyber events in ways that maintain the confidentiality, integrity and availability of data and services.

Calling cyber defense a "bit of a failed concept" for hospitals, Harnish recommends facilities not give up on prevention but at the same time develop contingency planning and train their staffs in how their organization will deal with the loss of information systems as a result of such cybersecurity incidents.

John Glynn, chief information officer at Rochester Regional Health, another integrated healthcare delivery system serving Western New York and the Finger Lakes region, says the ECMC ransomware attack "really got the attention of our board—I'm getting sick just thinking about it."

Glynn notes that in the aftermath of ECMC's cybersecurity event, one of the benefits for Rochester Regional Health was it forced the organization to "do more system-wide downtime preparedness drills than maybe we had previously." He acknowledges there are "multiple vectors of attack" that healthcare organizations must be prepared for, which is difficult because of the wide range of cyber threats confronting them.

"The attackers are always going to find a way in—that's why it's really essential to be able to quickly detect and respond," adds Meditech's Armstrong. "These are complicated problems. When an attacker gets into a system, you want to make sure that the ransomware is gone and they didn't leave any backdoors in so they can come back later."

Hospitals "need to be prepared for when prevention breaks down," Harnish says. "Insulating patients from cyberattacks has to be their No. 1 priority because it's potentially an issue of life and death." ∎
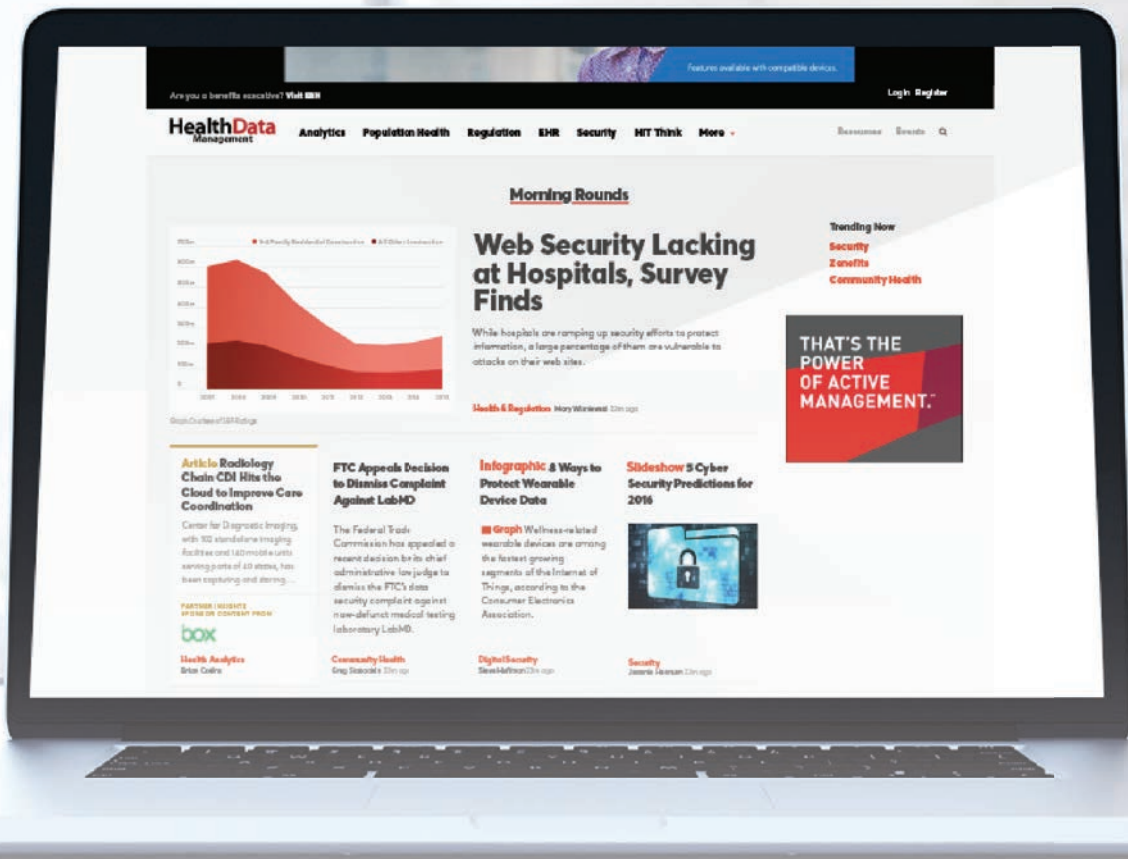
TOP VENDORS FOR
POP HEALTH

Providers look for help to meet value-based care challenges.

By Fred Bazzoli

As value-based care takes hold, healthcare organizations are looking to better manage populations of patients to ensure care is timely and effective. Information systems are crucial in both collecting and analyzing data, and developing actionable results that can impact care.

Population health management applications aim to help providers improve operations. KLAS Research, which studies the use of IT in healthcare organizations, sees six areas of functionality that are essential in population health management solutions. These include:

• Data aggregation, the compilation of data from disparate sources.

• Data analysis, which helps to stratify a population across risk factors and make predictions.

• Care management, which enable managers to track, plan and coordinate care for a population.

• Administration and financial reporting, which use dashboards and reports to analyze financial and clinical results.

• Patient engagement tools, which help to communicate with patients and track outreach.

• Clinician engagement functionality, which enables physicians to use population health management data at the point of care, while also tracking utilization.

In a recent report on population health management, KLAS Research identified 12 vendors that are among those most depended upon by providers to help them direct care of various patient populations. This list summarizes KLAS' study of the various leading vendors.

Allscripts
Allscripts offers population health management solutions that work in tandem with its electronic health records system. Its platform is a combination of both acquired and native solutions. Some of the tools under the CareInMotion solution are dbMotion, Care Director, Care Management, Care Team Management, Referral Management, CarePort, Chronic Care Management, FollowMyHealth and Population Health Analytics.

Arcadia Healthcare Solutions
Arcadia combines population health management tools with consulting services. The tools were originally built to be used by the company's consulting clients, though non-clients now use its applications—customers now include clinics, large national acute care organizations and health plans.

Athenahealth
The company offers a vendor-agnostic PHM suite that includes tools for claims data and business intelligence functions. The company also engages in risk-based profit sharing with some of its PHM customers.

Cerner
Cerner's HealtheIntent platform for PHM is EMR-agnostic, aggregating data on the front end and then serving it up to several different applications, ranging from registry and analytics to care management solutions.

eClinicalWorks
The company's Care Coordination Medical Record has several different modules for data exchange, analytics, patient engagement and care management, working in a coordinated fashion with eClinicalWorks' EMR and practice management systems. The application is not sold outside of the vendor's EMR customer base.

Epic
The Epic population health management functionality falls under the umbrella name of Healthy Planet and is part of the Epic EMR. As a result, the company's customers don't have to deploy an additional module to get access to Epic's population health functionality.

Forward Health Group
The company has many ambulatory practice customers, but clients also include medical centers and health systems. Typical population health customers tend to be involved in accountable care organizations, quality initiatives and pay-for-performance programs.

Health Catalyst
Health Catalyst's analytics and data visualization capabilities have been used by healthcare organizations for years, and many of the customers for these products are beginning to use the company's population health management applications to further leverage their data. Even those that don't are using its enterprise data warehouse for activities related to population health management.

HealthEC
A recent entrant to the PHM field, HealthEC has been processing claims data since the 1990s. Its customer base is mainly composed of midsize acute care organizations—many of its clients are independent, physician-led organizations, and they tend to need to bring together data from a wide variety of sources.

Lightbeam Health Solutions
Lightbeam offers a cloud-based, vendor-agnostic PHM solution that includes analytics, care management, patient engagement, quality reporting and an enterprise data warehouse. Its strengths are providing insightful financial and clinical information for the administrative staff of an organization.

NextGen Healthcare
The company offers a vendor-agnostic PHM product with several applications geared toward preparing and analyzing data to make it useful for care coordinators and physicians. The platform was developed by EagleDream Health, which NextGen acquired.

Philips Wellcentive
The Wellcentive brand is a longstanding player in the PHM market, offering a variety of functionality important to managing populations of patients. Customers range from midsize ambulatory practices to hospitals, ACOs, integrated delivery networks and large health systems.

GROUPS MAKE THE SHIFT
TO VALUE

IT is crucial in successfully taking on more risk.

By Maggie Van Dyke

Physician groups that have been aggressive in their pursuit of value-based care are making progress toward the Institute for Healthcare Improvement's Triple Aim of improved patient experience, lower total costs and enhanced population health.

Progressive physician groups say several key competencies aided by IT, ranging from care management to data analytics, must be honed to survive and flourish as fee-for-service payment shifts to fee-for-value.

With the introduction of the Quality Payment Program in 2017, Medicare is tying a portion of physicians' fees to their performance on quality and cost metrics. QPP also encourages physicians to move into Advanced Alternative Payment Models, which require physicians to take on downside financial risk, or cover some or all costs that exceed predetermined spending targets for a patient population.

Preparing for risk-based payment takes a combination of conviction and data, says Jeff James, CEO of Wilmington Health. "Our strongest point is that we have people with different talents who are really committed to what we're doing, and we use the data as the main tool to do it."

A commitment to value needs to begin at the top, says Scott Hines, MD, chief quality officer and chief medical officer, Crystal Run Healthcare, Middletown, N.Y. "To do this well, you have to really reconfigure the way that you do things in the practice, to focus even more than before on quality, experience of care and cost of care. You can't just form an ACO committee. You have to go down to the grassroots level, convince the physicians

that this is the best way to deliver care."

Leaders at Crystal Run, an independent, multispecialty group, are continually selling their vision to the practice's 400-plus physicians. In 2010, Hines and another senior leader met with small groups of physicians to explain why the practice needed to transition to value-based care. "Since then we continue to beat the drum," Hines says. Quarterly meetings update physicians on the practice's progress; division and department leaders attend a Leadership Academy to learn key performance improvement competencies; and new physicians go through an orientation on the practice's value-based approach.

Physicians also need to see that the practice is investing in key resources that will help them manage patient populations. A recent American Medical Group Association survey found that "hiring care coordinators" was the most-cited investment among AMGA members preparing for risk-based payment.

Other key investments revolve around using data analytics. "Business intelligence is really important," says Marshfield Clinic's Kori Krueger, MD, medical director, Institute for Quality, Innovation and Patient Safety. "It's hard to be strategic about where you're going, understand what your clinical outcomes are, and achieve financial targets if you don't understand the current state and how that differs from the state you'd like to achieve."

Data analytic needs

A lack of data to inform population health and improvement efforts is not an issue among leading-edge group practices, which have had EHRs for years. The opposite is actually the problem.

"Our biggest challenge is taking all the massive amount of data we have and trying to boil it down into actionable information," says Rick Rinehart, CIO and vice president, information technology, The Carle Foundation, Urbana, Ill.

Two types of actionable information are critical: risk stratifying populations and

identifying performance improvement opportunities.

Risk stratification

Segmenting a patient population into high- vs. low-risk groups helps physician groups prioritize those patients who most need care management. "You've probably seen the Medicare numbers where 20 percent of patients are responsible for 80 percent of the costs—the 80/20 rule really works in healthcare," says John Cuddeback, MD, the AMGA's chief medical informatics officer.

Sophisticated risk stratification models identify patients when they are beginning to deteriorate and are likely to be admitted to the hospital or visit an emergency department in the next six months, Cuddeback says. By contrast, first-generation approaches, which have been used by insurers for decades, tend to identify high-risk patients after they were admitted to the hospital or visited an ED. These older models often rely on claims data or after-the-fact billing codes submitted by providers to describe healthcare services provided to patients.

Physician groups with EHRs containing up-to-date biometric information, including blood pressure and glucose readings, can develop predictive models capable of identifying patients who are on the cusp of a downward spiral. "The big advantage of including clinical data in your analytics is you can see patients as their clinical parameters are beginning to deteriorate, and you can predict not just a readmission but an initial hospital admission," Cuddeback says. "This is a great time to intervene."

The Carle Foundation has created disease registries within its Epic EHR for asthma, diabetes and other conditions. The vertically integrated network, which includes Carle Physician Group and Health Alliance Health Plans, developed its own risk score to help segment these disease populations. "We have a means of stratifying that subset of a population to understand who's at most risk for disease advancement because of their latest lab values or because they haven't followed up on some of their health and wellness maintenance," says Suzanne Sampson, system vice president for information management and analytics, as well as project management. "Through that functionality, we can do direct outreach to those patients very efficiently."

Other group practices are investing in risk stratification software products. For instance, Crystal Run Healthcare uses Crimson Population Risk Management to identify those patients most in need of care management.

Stratifying a population by patients who did or did not receive critical screenings or lab tests is different from identifying those patients likely to be admitted to the hospital in the next six months, Cuddeback says. EHRs on the market can be programmed to send alerts about so-called gaps in care, like missed screenings, but fall short of predicting outcomes. "When you're talking about predicting risk for poor outcomes, you need more sophisticated analytics," he says.

Performance improvement

Marshfield Clinic's population health dashboard tracks 160 quality and cost measures, pulling data from the organization's robust EHR and data warehouse. Physicians can see how well their patient panels or individual patients are doing on specific metrics and compare their scores against those of other physicians, while senior leaders can compare performance across different locations and over time.

"That dashboard is 100 percent transparent to everybody in clinical care delivery throughout our organization," says Krueger. "Using a drill-down application, they can immediately see all the way down to individual provider-level performance on any measure."

The dashboard has made it easier to engage physicians around organization-wide efforts, such as the blood pressure improvement initiative that began in 2015.

"We used our medical record and our data warehouse to understand the population of patients who have elevated blood pressure and hypertension, and we put together a strong response for managing that population," he says.

The initiative has enlisted all physician specialists, from dermatologists to plastic surgeons, in tracking blood pressure rates and ensuring any patient with high blood pressure is referred to a primary care physician for followup. "We developed some other dashboards for our medical subspecialties where they can see things like how often patients show up in their office with a blood pressure outside the desired range and how often staff appropriately take a second blood pressure in those cases," Krueger says. As a result, Marshfield Clinic has increased the percentage of people with controlled blood pressure of 140/90 or lower to the high 80 percent range, from the low 70 percent range in 2015.

Crystal Run Healthcare's business intelligence team has also been enlisted to help guide performance improvement. One tool it built helps pinpoint variation in physician treatment approaches, which informs best practice discussions. "If you had two people, same age, same sex, same genetics, who both had hyperthyroidism, and they saw two different doctors in the same organization, you would think they'd be treated in relatively the same way," says Hines. "But we've found that's not the case."

The variation tool compares the overall charges per patient per year for specialists treating the same disease. For example, when looking at diabetes, the tool shows each endocrinologist's average charges per patient for the past year.

"No matter what diagnosis, no matter what specialty, we usually find a three- to four-fold variation between the providers on the left and right side of the graph," says Hines. "The reason is not that some providers have sicker patients or that others have better quality. The reason is a lack of awareness of, and adherence to, evidence-based practice guidelines." ∎

VISIONARIES

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[1] Bridget C. Booske et al, "Different Perspectives for Assigning Weights to Determinants of Health," http://www.countyhealthrankings.org/sites/default/files/differentPerspectivesForAssigningWeightsToDeterminantsOfHealth.pdf, February 2010

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David E. Glowacki, VP Technology, LexisNexis Health Care
Jeff Diamond, Vice President of Market Planning and Product Management, LexisNexis Health Care

What emerging technologies hold the most potential for the healthcare industry?

Two areas in which we're innovating are block chain and machine learning. Both require a vast quantity of high quality data, which gets to the heart of what LexisNexis® Health Care does.

Blockchain has potential to transform healthcare and fix some of the more difficult issues that currently plague the industry. It could be used to create a common, highly secure database of health information that doctors and providers could access, facilitating better patient care and better sharing of research for new drugs and treatments.

In machine learning, we're involved in collecting and integrating vast data sources including public records data, healthcare provider data, claims data, business data and more. When that data is put into predictive models, it can identify health risk. With insights gleaned from data, medical personnel don't have to wait for a patient to display symptoms before taking action. They can focus on prevention to avoid disease, health complications and hospital readmissions.

What are the challenges associated with strategically implementing innovative technologies?

Most organizations are managing multiple priorities, which can limit their ability to develop a change management strategy. Innovative companies recognize the cost and time investment associated with implementing new technologies but place a higher value on the benefits that will result.

They foster an innovative culture that encourages people to think independently and be open to different perspectives. They empower employees to be creative by dedicating resources in time and money. They involve the primary stakeholders in development. Post implementation they work toward ensuring the technology is adopted and being used by stakeholders, while always driving toward that ROI.

How can innovative technologies help healthcare organizations achieve the coveted triple aim?

We believe data can greatly contribute to improving the patient experience, improving the health of populations and reducing the per capita cost of health care.

The amount of available data is growing exponentially. Socioeconomic data, claims data and personal fitness data can all be integrated with a patient's medical history to provide a clear, comprehensive lens into that person's health. A bigger picture allows you to more easily identify a patient who is at risk and intervene to

prevent a medical episode, one that might involve costly treatment or chronic care. The same idea can be applied to the population at large. When you aggregate large amounts of disparate data and link them together, you can see patterns, track trends and draw insights that might not otherwise be apparent. The data can be analyzed to understand patient behavior and then drive smarter decisions about intervention and treatment options.

How can organizations justify investments in new technologies?

At LexisNexis, a big part of what we do for our clients is promote innovation by harnessing the power of data and transforming key work streams. We enable healthcare organizations to leverage data and analytics to manage patient and provider information, improve health outcomes, identify market opportunities, reduce fraud and ensure compliance. We help them to use data technology in ways that mitigate their risk while improving their efficiency.

In today's fast-paced world, the real question isn't, "How can organizations justify investments in new technologies?" It's "How can they NOT justify those investments?"

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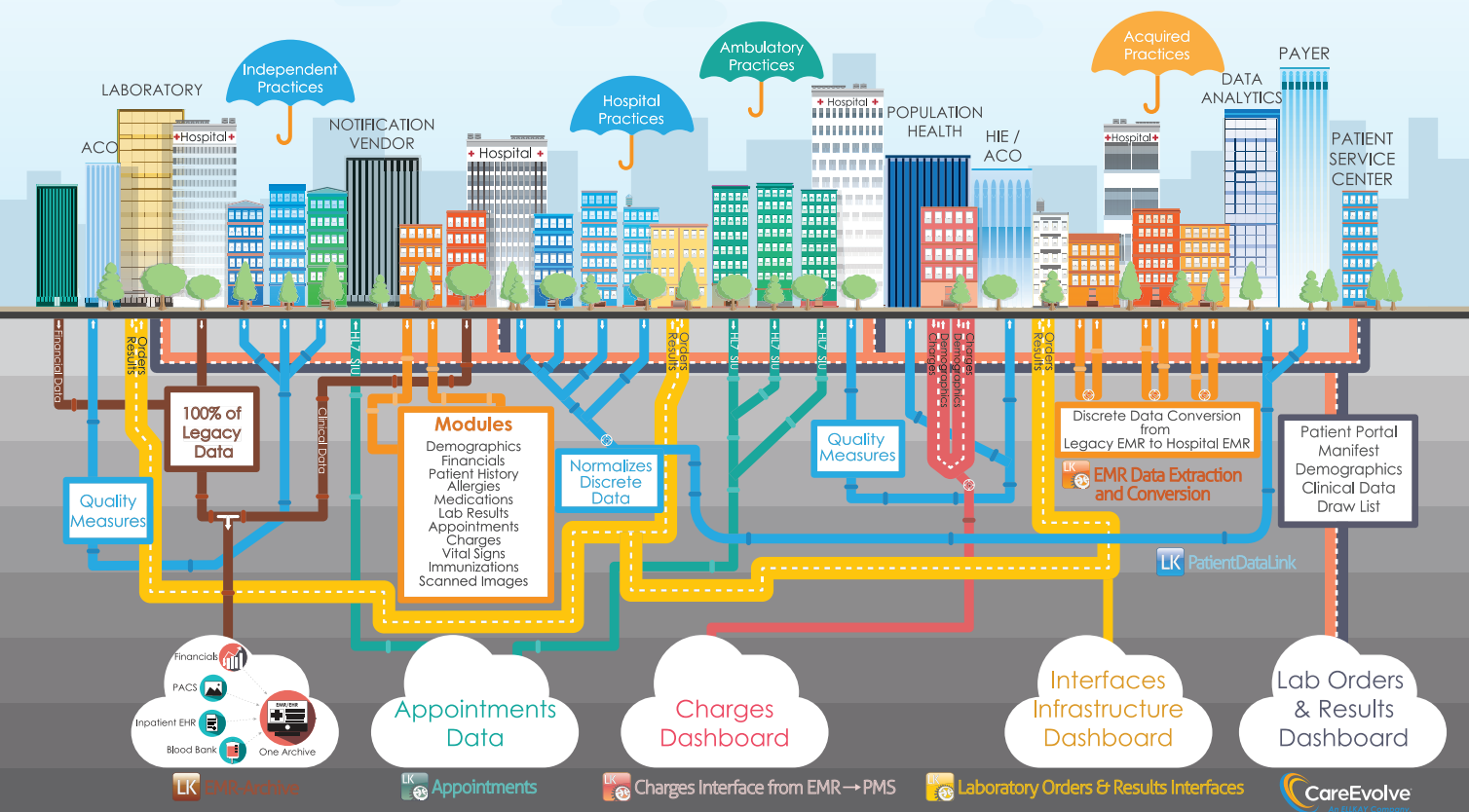
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Kamal Patel, Chief Information Officer, ELLKAY

What emerging technologies hold the most potential for the healthcare industry?

In today's evolving healthcare environment, we are experiencing the impact of an influx in healthcare data, health systems moving away from legacy systems and archiving data, and an increase in solutions for patient involvement towards a value-based healthcare system. Simultaneously, there are technological advances and innovations in response to these trends.

As patients become more engaged in their healthcare experience, providers want the technology and tools to communicate with patients and provide the best care possible. An increasing amount of applications are being developed to foster that involvement, such as Rx.Health by Mount Sinai, which treats mobile applications as prescriptions for patients.

However, with patient's involvement, health systems and hospitals must now have the ability to manage the clinical data exchange with a robust communication platform. An influx of data, coupled with managing it from disparate systems, necessitates a data interoperability platform that can move discrete data across all parts of the healthcare network, enabling internal management and data tracking. The development of economical clinical data exchange platforms that can empower health systems to track clinical data requests and responses, search documents easily, validate if documents are CMS RADV compliant, and identify RAF scores are all critical for increased reimbursements in value-based models.

Cost-cutting technologies like interface

engines are near the top of the innovation list. Instead of building and implementing new interfaces each time, cloud-based interface platforms allow health systems and laboratories to reuse existing interfaces. They allow for non-technical resources to easily configure interfaces using drop-down lists and achieve super-fast deployments – sometimes within minutes. Another significant cost-cutting technology is legacy systems archives. As health systems become increasingly reliant on their EMR, they are looking for streamlined ways to access the data stored in their legacy systems. Archive systems link directly to the EHR and offer an alternative to read-only data, complying with federal regulations and maintaining continuity in patient care by retaining access to patient data in an actionable, economical, and meaningful format.

What are the challenges associated with strategically implementing innovative technologies?

With archive systems, for example, the biggest challenge is for health systems to be aware that the option to shut down expensive maintenance fees for their legacy systems even exists. Once they invest the initial few weeks to understand the processes, options, and workflow, then additional attention to proper resource allocation is also important.

With the implementation of modern interface platforms, an initial challenge is understanding an entirely new concept and how that new tool can solve an immediate challenge. When CIOs commit and recognize the long-term benefit of an interface engine strategy, they can drive the shift in how their personnel resources are used, relying on project managers to execute the strategy

rather than leaning on developers to create new projects all the time.

How can organizations justify investments in new technologies?

Hospitals and health systems investing in new technologies, particularly some of those we have explored, will actualize significant savings quickly. Often, it is a small investment in the short term for substantial positive revenue impact in the long run.

Investing in archive systems reduces ongoing costs and enables the retrieval of consolidated legacy patient data stored in various systems from within their primary EHR – making it easy-to-use and simple. A cost effective clinical data exchange platform provides a holistic view of the patient's history from various sources, helping to decrease duplicate testing, improve the patient's experience and engagement, and document for quality and risk.

Interfaces that are speedy to implement significantly reduce development costs, saving health systems the time and resources associated with hiring interface developers with high salaries. In less time and with faster deployment, an interface engine changes the development timeframe from months to days and sometimes minutes.

Tools and technologies like these, and others, have been developed in response to market needs and challenges. They have the potential to not only improve how healthcare is delivered, but also transform the operational and financial workflow that will result in a significant, positive, economic impact.

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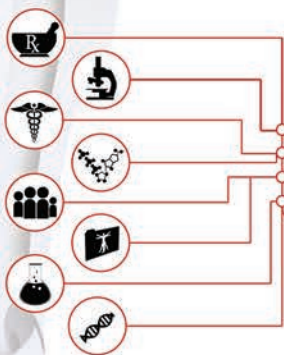
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Slava Akmaev, Ph.D., Head of BERG Analytics

Value-based care is on its way toward becoming the dominant care delivery model in health care. What technologies do health-care organizations need to implement to succeed under this emerging model?

The pay-for-performance model is a critical next stage in health-care dynamics – not only in the U.S., but around the world. Health-care services, procedures and medical interventions are becoming more sophisticated and, at the same time, more expensive. Because of the high cost of new gene-editing technologies – some have price tags of up to $1 million – patients and payers want the reassurance of treatment efficacy at the individual level.

As more sophisticated, expensive and complicated treatments come to market, the concept of assessing intervention success on "average" will fade away. The industry can not justify 20% efficacy statistics, as on the other side, 80% of the population have no benefit from the intervention. Currently, payers reimburse failed treatments en masse, and this has only been possible in health care. But this approach is rapidly changing as health-care costs rise.

Precision medicine tools – specifically advanced analytics and artificial intelligence – will gain significant market share in health information technology within the next five years. Deep analysis

and interpretation of the available molecular data (such as genomics and metabolomics) is necessary to drive the specificity of care. Also, new waves of mobile data, thanks to wearables, are flooding the health-care market.

Improved patient engagement is an imperative for health-care organizations. How do you envision health-care organizations using smart devices and other consumer-facing tools to more fully engage patients in their care?

Many organizations are already collecting and/or monitoring patients' vital data via mobile tech, so I see substantial growth in the telemedicine market over the next decade. Smart mobile devices and wearables are making tremendous strides, starting with heart-rate monitoring and the recent advancement of EKG recording on smart watches. Most likely, we'll see widespread adoption of telemedicine in Asia and the developing world before it impacts the U.S. and Western Europe.

Staffing has emerged as a major challenge for health care. What staffing strategies can health-care organizations adopt that will enable them to fully leverage technology innovations?

Training in IT, data science and machine learning are requirements for the successful implementation of data-driven strategies in any health-care organization.

Where telemedicine, advanced analytics and artificial intelligence are typically not well developed within health-care environments, health-care organizations must decide whether to buy or hire. While some of the largest pharmaceutical companies are widely adopting data-driven approaches within their organizations, and making the transition to the data-and-medicine philosophy, growing such capabilities internally is a formidable task for most health-care organizations.

Artificial intelligence is having a significant impact on how businesses and consumers use technology. How can health-care organizations best leverage AI technologies?

Artificial intelligence is a big term that is often overused. Data research has played a vital role in health care for decades, with statisticians and medical informaticians successfully using data-analysis tools to predict outcomes. It's important to understand that AI allows researchers and clinicians to identify key insight in myriads of data points in a hypothesis-free manner. Advanced predictive methods can help health-care organizations to better manage complex treatment pathways, identify patients at risk of complications and adverse drug reactions, and ultimately provide personalized care leading to better outcomes.

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Joe Cisna, MBA, MHA, CHP, Healthcare Solutions Manager, Konica Minolta

Value-based care is on its way toward becoming the dominant care delivery model in healthcare. What technologies do healthcare organizations need to implement to succeed under this emerging model?

The technologies needed to realize the shift to value-based care include interoperability and population health management. Interoperability, such as Direct Messaging, Health Information Exchanges, HL7 and APIs, allows timely patient data liquidity between disparate systems, giving providers complete patient records at point of care for more informed decisions. A complete patient story includes clinical, financial and social determinant data (both structured and unstructured).

With complete patient data, Population Health Management solutions will leverage predictive analytics, NLP and ML to increase risk stratification accuracy, improve quality, measure outcome, and deliver comprehensive yet personalized care management.

Improved patient engagement is imperative for healthcare organizations. How do you envision healthcare organizations using smart devices and other consumer-facing tools to more fully engage patients in their care?

As providers explore the quiet revolution of digital healthcare, they are realizing that smart devices are vital for a connected, digital healthcare organization to provide the best patient care available.

Smart devices and consumer facing tools empower patients to take greater ownership of their healthcare . For example, implantable metabolic devices measuring glucose levels for diabetic patients and mobile apps for more effective patient portal access and engagement could play a big role and change the way providers interact with patients. The best patient engagement tools connect people in non-intrusive ways and can easily adapt to natural thought processes and behavior.

Staffing has emerged as a major challenge for healthcare. What staffing strategies can healthcare organizations adopt that will enable them to fully leverage technology innovations?

With the rapid pace of innovation, cybersecurity risks, and complex regulatory environments, healthcare organizations must implement strategies to maximize process efficiency. Workflow automation, utilizing content management systems and more esoteric technologies like mobile video robots can dramatically improve efficiency and allow staff to focus on patients. Challenging areas like cybersecurity can be improved by partnering with a managed security services provider. Healthcare organizations need a technology partner who knows the organization's culture and business needs and offer needed solutions and services. This eliminates the need for hiring resources to maintain a 24X7 service, but compliments the internal resources with external teams who offer expertise and knowledge, and assist with the implementation.

Artificial intelligence is having a significant impact on how businesses and consumers use technology. How can healthcare organizations best leverage AI technologies?

As healthcare organizations gather large quantities of data through interoperable exchange from multiple and often disparate datasets, the efficient processing, analysis and utilization of that data for patient care becomes critical. AI technology has the potential to leverage machine learning capabilities enabling accurate and real-time decision making, improving overall operating efficiency and reducing unnecessary costs. With AI, health systems can reduce the costs of treatments and optimize their organization's processes. Through innovative approaches like smart assistants, computer-controlled or robotic therapeutic systems which integrate into streamlined clinical workflow, AI can improve healthcare delivery and patient experience, care plan adherence, outcomes and reduce costs.

Data security remains an ongoing challenge for healthcare organizations. What technologies can healthcare organizations use to better protect data?

Safeguarding patient data is the top priority for any healthcare organization. Also, healthcare organizations must be compliant with extensive regulations (HIPAA, HITECH, etc.). Securing PHI and guarding against ransomware are just two cybersecurity concerns to address. The growing use of connected devices to treat patients also significantly increases the risk. The key is to make sure technology is being used to constantly monitor the networks against vulnerabilities at various levels (external, internal and wireless). Proactively monitoring the networks and, if a breach occurs, having a capability to isolate the systems and address the breach is vital.

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Niki Buchanan, Business Leader, Philips Wellcentive

What emerging technologies hold the most potential for the healthcare industry?

Artificial Intelligence: Bringing its promise back to earth. HBR and others have reported on the importance of forgoing the moonshot of AI by identifying pragmatic applications of it. While health systems remain skeptical about the hype, deploying AI for business process improvements, supercharging analytics, and engaging patients has real promise. We're deploying AI to predict risk in both home and care settings to drive better outcomes and lower costs.

Actualizing Interoperability with brains, brawn and lessons learned. Today's health systems find themselves wrapped in a "quilt" of solutions as they add a deluge of new technologies to their existing platforms. There is no single-vendor solution, and there is no substitute for insights, experience and doing the hard work to create accurate, actionable and truly interoperable data. While there are no shortcuts, the potential rewards are great, as the right population health management (PHM) solutions can provide comprehensive insights from outside the health system and across populations to drive true value-based care.

Telehealth: More than a technology. Many see telehealth as a technology, but its genuine potential is found in its power to create a new access point and drive patient choice. Providers must be intentional about how and why they engage in virtual care. Telehealth is more than a substitute for how we've delivered care for hundreds of years. It is paving a path for a new care delivery model.

What are the challenges associated with strategically implementing innovative technologies?

Illuminating blind spots: Seeing beyond the EHR. Our analysis shows that even in markets with a "dominant" EHR, more than 40% of these delivery areas are strewn with many other vendors. When so much critical data exists outside the EHR, providers need visibility to a patients' longitudinal care journey. EHRs will remain an important contributor, yet we need truly integrated data across the care continuum to keep populations healthy.

Clinician time is under siege – optimized workflows are more important than ever. A primary care visit lasts just 18 minutes, but doctors must cover seven issues during that time. Given that some 50% of clinicians' time is spent engaging with the EHR, less time is available to view the patient holistically. Getting longitudinal data in the workflow, at the point of care, is critical. We're partnering with other companies to provide that relief.

Partnerships are perishable. As new technologies enter the market, so do a barrage of new vendors offering them—opening a floodgate of innovation. However, providers and vendors alike must carefully weigh new entrants and their ability to survive long-term to separate those with transformative merit from those that cannot stand the test of time. The cost of disruption caused by innovation that lacks enduring value is too high.

How can innovative technologies help healthcare organizations achieve the coveted triple aim?

Accelerating time to treatment. Telehealth plus predictive analytics improves access, builds workflows around patient needs and speeds their care. Partners Healthcare used the predictive capabilities of Philips CareSage and remote patient monitoring to reduce the risk of emergency transport in a frail elderly population, avoiding an estimated 224 hospital admissions and saving $2.2M.

Hardwiring population health, now. Improving the health of populations can happen quickly. Ascension Medical Group at Borgess used our platform to identify, target and outreach to their diabetic population that had uncontrolled blood glucose levels. They set a lofty goal of reducing their hemoglobin A1c levels by 20% in one quarter. Our platform revealed that over 67% weren't being seen in the office. Impressively, they exceeded their initial goal and have sustained improvements since the program began in 2015. They are a great example of having "hardwired" population health in their new care models.

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Garri Garrison, Vice President of Performance Management, 3M

What emerging technologies hold the most potential for the healthcare industry?

New and emerging technologies that address the growing demand for performance management analytics hold significant promise. Although industry organizations are already using a variety of analytics tools today, I don't think these tools have reached their full potential. Many provider and payer organizations continue to focus on single vertical views of data—within just one facility, for example—rather than analyzing operational outcomes across healthcare delivery systems and patient populations. We have to understand interdependencies between sites of care, as well as caregivers, if we are to uncover meaningful data insights. Only then will we be able to identify the root cause of inefficiencies and promote real and sustainable improvements in healthcare quality and cost.

We also will see consumer-directed care programs become more mainstream as patients become more actively involved in managing their own care. This trend will be enhanced by technology advancements and further investment in telemedicine and virtual health. Also, watch for more innovation on the horizon related to the Internet of Things. Faced with many competing priorities, healthcare organizations must determine how best to leverage these emerging technologies to improve patient care and lower costs.

What are the challenges associated with strategically implementing innovative technologies?

New technologies, tools and platforms often come with people and process challenges. Change can be difficult for medical and operational teams, making change management an essential component of any technology implementation. Culture is a word we hear a lot lately, but the culture of your organization can create roadblocks and ultimately be a huge factor in whether a new technology succeeds. We've also seen organizations underestimate the importance of planning for scale when designing a data architecture strategy. Associated with that, organizations need to factor in data normalization needs and consider any issues in securing data use rights. Both issues must be carefully considered during the planning process to prevent problems down the road.

How can innovative technologies help healthcare organizations achieve the coveted triple aim?

Providers and payers share similar goals centered around the three dimensions of the Triple Aim. The most effective way to achieve these goals and reduce costs is to adopt technologies that foster collaboration between payers and providers. Payers should share as much data as possible with providers and invest in the data infrastructure needed to give providers point-of-care access to information. Payers should invest in tools that are proven to lower medical and administrative costs and enhance quality of care—and then share these tools with providers. Examples include tools that stratify clinical risk and analyze pathways of care, allowing care management teams to focus on the critical few. Likewise, providers must be willing to make a concerted effort to improve data quality and incorporate administrative claims data and other types of data from payers into their daily workflow. This includes data about access patterns or data about patients whose disease progression varies from the norm.

How can organizations justify investments in new technologies?

Regardless of the investment, healthcare organizations should always ask three key questions when allocating budget dollars: Will this investment improve patient care? Will it help us be more efficient at delivering care? Will the investment help lower costs? Answering 'yes' to these questions directly connects the investment to the Triple Aim. Investing in new technology is no different. A healthcare executive should take a hard look at emerging technologies with these same three questions in mind.

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RACING TOWARD INNOVATION TO IMPROVE THE CARE EXPERIENCE

Sachin Gupta, MD, a pulmonologist and technology enthusiast, is predicting an explosion of digital innovation in healthcare.

"With respect to digital health, I think there's a bit of an arms race going on between hospitals right now," Dr. Gupta said. "Digital innovation pilots are happening in many health systems because patients are demanding to receive care with these innovative tools. So, hospitals and health systems are going to be forced to adopt innovative technologies whether they want to

Psyche Systems Inc.

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Lisa-Jean Clifford, Chief Executive Officer, Psyche Systems Inc.

What emerging technologies hold the most potential for the healthcare industry?

Telemedicine, interoperability and IoT are the emerging technologies that hold the most long-term potential for providing a platform for continued technological development and expansion in the healthcare industry.

What are the challenges associated with strategically implementing innovative technologies?

The biggest challenge is understanding the new technology along with the potential and practical uses of it. Once you have the knowledge - and a comfort with it – you can create a strategic vision. You will need a short-term vision to test your theory and direction and a longer term vision to build towards which will allow you to realize maximum potential.

Another common challenge is building consensus within your organization. Getting others on board with your vision and in some cases that includes the necessity of educating them on the potential of the new technologies.

There is always the budget procurement issue. With a well vetted vision and articulate plan, the budget process should be fairly simple.

How can innovative technologies help healthcare organizations achieve the coveted triple aim?

The direction the entire healthcare industry is moving in is toward the triple aim. It will be necessary to incorporate innovative and new technologies to even imagine the achievement of the triple aim. You must consider the need for interoperability, population buy-in for their participation and usage, and the healthcare entities IT infrastructure needs. All of this is necessary to understand the puzzle and how the pieces need to communicate in what I am now calling a full-directional fashion. Interfaces are only built to be unidirectional and bidirectional. What I am referring to is interoperability–it is full circle communication of data between multiple parties, including applications and IT middleware.

What are the best practices associated with a successful new technology implementation?

Proactive communication and a solid implementation plan are the keys to any successful implementation. You need to understand the strategy and objective, the timeframe and to have the right people on the team. Everyone must be clear on the outcome you are all targeting and the steps necessary to get there. Each team member must be clear on their role and what is considered successful completion of their role in the overall plan. Regular communication between all parties is necessary and interdependencies must be clearly highlighted. Team members who are able to help each other in covering key areas of knowledge and skill are extremely helpful.

Testing, testing and more testing. Be prepared with a test plan for every scenario or use of the applications and technology and be ready to adjust if necessary. Understand what constitutes a successful launch.

Do not drop the project once it is 'live'. Audit and revise if necessary so that advances in the industry aren't lost because your implementation became stale. Update and rework your workflows if necessary to continue to expand on the potential uses and take advantage of new directions that your technology platform can move in.

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Consumers are now taking financial responsibility because of all the high deductibles, high out-of-pocket healthcare expenses. So, they are more cognizant of the quality of care that they are receiving.

or not. And I think they want to, because they are also interested in their bottom line."

Indeed, the healthcare industry is moving toward the increased use of a variety of innovative technologies including telehealth, Internet of Things, artificial intelligence, virtual reality, wearables and others (see sidebar).

Much of this growth can be attributed to the need to meet consumer expectations in an increasingly connected world.

"Consumers in healthcare have changed quite a bit. Consumers are now taking financial responsibility because of all the high deductibles, high out-of-pocket healthcare expenses. So, they are more cognizant of the quality of care that they are receiving," said Paddy Padmanabhan, author of The Big Unlock and CEO of Damo Consulting, Oak Brook, Ill. "If consumers don't have a good experience, they're not going to come back. So, in order to provide consumers with a good experience, healthcare organizations need to start digitizing their experiences. Organizations can start by giving them the tools, mobile apps and handheld devices that can improve the care experience."

Studies Show Market Growth for Healthcare Technologies

- As healthcare organizations move toward increased innovation, a variety of technology markets are expected to experience growth:

- The global market for healthcare artificial intelligence software, hardware and services will increase from $235 million in 2016 to $19.3 billion by 2025, according to Tractica.

- The global telehealth market is expected to reach $12,131 million by 2022, growing at a compound annual growth rate of about 30.1% between 2017 and 2022, according to a report from Zion Market Research.

- The world Internet of Things healthcare market is expected to reach $136.8 billion by 2021, growing at a CAGP of 12.5% between 2016 and 2021, according to research from Research and Markets.

- The augmented and virtual reality in healthcare market was valued at $769.2 million in 2017 and is expected to hit $4,997.9 million by 2023, a CAGP of 36.6% during the forecast period, according to a report from Markets and Markets.

- The healthcare wearables market will exceed revenues of $10 billion in 2022, according to a market forecast from ABI Research.

- The health intelligent virtual assistant market hit $180 million in s018 and is expected to grow at a 31% CAGR from 2017 to 2024, according to research from Global Market Insights.

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Casenet is a leading provider of population health solutions. Casenet provides healthcare organizations around the world a single, comprehensive experience with their members so they can effectively coordinate the delivery of care to individuals and populations at appropriate costs. Casenet aligns data and resources, so care can be managed with confidence. As a result, care teams can improve the delivery and quality of healthcare for everyone.

Peter Masanotti, Chief Executive Officer, Casenet

Value-based care is on its way toward becoming the dominant care delivery model in healthcare. What technologies do healthcare organizations need to implement to succeed under this emerging model?

Population health management (PHM) will eventually morph into a Health Engagement model and away from the "management" theme the industry has traditionally embraced. When patients are engaged in their own care, higher quality care and more meaningful interactions result. The stronger the patient engagement, the more likely a positive outcome which will drive success in a value-based care model. Technologies that streamline the management of patients with the most complex conditions while also maintaining the wellness of healthy as well as at-risk populations should be implemented to deliver on value-based care. For value-based care to progress, we must expand our discussion to leverage the technological advances in analytics, access to expanding data sources, and the evolution of care management systems enabling complex multi-role processes and engagement methods.

Improved patient engagement is an imperative for healthcare organizations. How do you envision healthcare organizations using smart devices and other consumer-facing tools to more fully engage patients in their care?

Improving patient engagement requires the implementation of consumer-facing tools that fit into consumer lifestyles and buying habits. These tools and smart-devices must be easy to use and acquire, serve multiple purposes much like the cell phones and downloadable apps of today, and be simple to maintain. Innovative health and wellness solutions such as consumer wearables with active monitoring, in-home monitoring and environmental assessment devices, user-friendly portals and virtual personal companions are necessary to get consumers more involved in their healthcare.

Artificial intelligence is having a significant impact on how businesses and consumers use technology. How can healthcare organizations best leverage AI technologies?

With the massive amount of data being gathered, collected in systems and accessed by clinicians, artificial intelligence (AI) is imperative to more quickly and precisely mine data to spot trends, identify risks and take actions. AI is already being used to improve x-ray scanning, more accurately identify cancers and further analyze lab results. AI can also be used in real-time to assist in the delivery of care from the operating room to the ambulance. AI clinical support can also be used for rural telemedicine and care coordination. The possibilities are endless if healthcare can be extended beyond cities and delivered to rural areas and countries where care access is often limited. In Copenhagen, dispatchers are already testing the use of AI to identify cardiac arrest symptoms purely from what is said to the dispatcher on the phone. This ability is extended even further if the AI analysis can then be used to dispatch a drone with automatic defibrillators to the location of the patient, alert the appropriate care teams, and automate the care coordination and follow up tasks required to manage this patient's eventual transition home.

As the capabilities of AI increase, it will be adopted more readily by clinicians and care coordination teams. This will enable earlier identification of illnesses and more rapid intervention resulting in the positive outcomes the industry expects from population health management and value-based care.

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About 80% of people are doing a Google search or some kind of digital search to find healthcare providers at a location near them.

Customer is king

As such, many trailblazing healthcare organizations are looking to get out ahead of the technology curve and provide consumers with what they want – and need. For example, AMITA Health has embarked upon what Deborah Fullerton, CMO and VP, calls a "digital retail journey" as the health system aims to focus keenly on the needs of patients.

"We held a retreat for leadership last spring about the consumerization of healthcare. Our leadership understands that we need to ensure our organization thinks and acts more like a retail environment," Fullerton said.

As part of this consumer-focused effort, the Arlington Heights, Ill.-based health system has implemented an online appointment scheduling system that intelligently matches patients with available healthcare providers. With this system in place, patients can use online search tools to access the AMITA Health physician directory and easily book appointments with providers who accept their insurance and match their individual healthcare needs. Patients can quickly see which providers are available at their desired times, without having to pick up the phone or wait on hold.

"About 80% of people are doing a Google search or some kind of digital search to find healthcare providers at a location near them. So, we are giving them a mobile-ready way to find the information that they need. We are making it possible for patients to tailor their search by ZIP code, specialty, ailment or physician. Giving them the

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Helen Waters, Executive Vice President, MEDITECH

Improved patient engagement is an imperative for healthcare organizations. How do you envision healthcare organizations using smart devices and other consumer-facing tools to more fully engage patients in their care?

At MEDITECH, we are dedicating the time, research, and investment into ensuring our customers and providers not only meet future health paradigm requirements but fully engage their patients in doing so. Physicians shouldn't be glued to a computer screen nor turn their back on a patient when they are documenting notes. A user-interface that is mobile with intuitive navigation, personalized views, customizable tools, tap-and-swipe capabilities, and is accessible on any smart device — will not only save physicians time but will help them to fully engage with patients at the point of care and influence the outcome of their care.

Consumers today are well-informed, tech-savvy, and with the amount of information available at their fingertips, are more likely to do research on a product or service. With that in mind, healthcare organizations and physician practices should offer tools to their patients that entice, empower, and engage them in their health. MEDITECH believes patients should have access to their entire medical record in order to be active participants in managing their health.

An integrated and interoperable patient portal is an effective tool that gives both care providers and their patients the resources to make preventable care a priority. With a portal, patients can book online appointments, set-up text reminders, complete questionnaires and pre-admission testing profiles, and even have video visits — all from the convenience of their home.

The ability to retrieve and consume Patient Generated Health Data (PGHD) that can integrate with an organization's EHR and patient portal is equally as important. Whether a patient is entering details about their care via telehealth devices or by syncing their personal activity trackers — the data collected can help providers improve the quality of care and keep more patients healthy, out of the hospital, and receiving care in a setting that is most comfortable for them.

Value-based care is on its way toward becoming the dominant care delivery model in healthcare. What technologies do healthcare organizations need to implement to succeed under this emerging model?

Value-based care is more than just a shift in how outcomes are viewed, it's a shift in how healthcare is delivered. It's team-based care, proactive engagement by clinicians, and wellness promotion and accountability. In order to achieve better outcomes and ultimately lower healthcare costs, keeping patients healthy and out of the hospital is crucial. There needs to be technology to support these new roles and workflows, however, it's a two-way street — patients need to feel engaged and empowered to do their part and contribute to their own health and medical record.

To succeed under this emerging model, organizations need fully-integrated, interoperable, and intuitive tools that incorporate clinical workflows, advanced predictive surveillance features, patient registries, and state of the art analytics. Achieving quality outcomes and managing chronic conditions proactively start with proper documentation and surveillance within an EHR.

Healthcare organizations can begin the shift by discussing strategies for Population Health Management and using patient data to transition to a model of care that is truly value-based. MEDITECH is doing this through its collaboration with Arcadia Healthcare Solutions to integrate aggregated claims data into MEDITECH's Web Enterprise Health Record and Analytics solution for improved Population Health Management. The inclusion of data, such as risk scores and gaps in care, empower healthcare organizations to better understand their populations and position them well for the healthcare paradigm shift underway.

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Adding an easy, fast self-scheduling option is the next logical service improvement.

capability to search in a variety of different ways helps to create a better experience," Fullerton said. "Adding an easy, fast self-scheduling option is the next logical service improvement."

In addition to making it easier for patients to schedule appointments, the online scheduling system is also expected to enable AMITA Health to make improvements to the overall patient experience. Data gathered by the online system provides detailed insights into patient behavior, as related to existing workflows. As such, AMITA Health will be able to leverage this information to make changes that could improve the patient experience, provider productivity and staff utilization.

For example, a particular physician might have open schedule slots but the data could show that new patients are requesting appointments for Fridays, a day that the physician has fewer appointments. As such, AMITA Health will be able to better "align supply and demand," Fullerton said.

The online scheduling system is just one of many technologies that AMITA Health is using to improve the overall patient experience. The healthcare organization is implementing a variety of consumer facing technologies such as:

An omni-channel contact center. "This center will enable consumers to communicate with us in the medium they choose, whether that's texting or email or phone call or snail mail," Fullerton said.

AMITA Health Check, a patient-generated health data app. This app simplifies complex care plans into daily steps/reminders and enables patients to communicate directly with their care teams about every aspect of health, from medication doses and side effects to follow-up appointments. The app uses artificial intelligence to customize a symptom word cloud. Patients also enter their pain levels and register their activities. All of these entries are monitored daily by nurses on a customized dashboard, which quickly identifies when patients need an intervention.

"AMITA Health first introduced this app to joint replacement patients because of the many activities required by patients before they show up for surgery – and the fact that if they fail to complete these, surgery would be cancelled, which is not good for the patient or the hospital," said Fullerton. "Now AMITA Health uses this app for patients with anxiety, depression, stroke and bariatric surgery."

 A medical transportation app. "This app uses Lyft drivers for patients who need follow-up physical therapy. A driver, with a special vehicle and who is specially trained to pick up healthcare patients is sent to pick them up," Fullerton said.

A behavioral medicine app. This app is initially being used with addiction patients. "It has a GPS, so if the patient is in an area that's near a temptation – say, their favorite bar – then it sends them positive messages and tells them where the nearest Alcoholics Anonymous meeting is," Fullerton said. The app also connects patients to

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DataBank provides secure data center, cloud, and interconnection services, offering customers 100% uptime availability of data, applications and infrastructure. Our technology solutions reduce risk, improve performance and ensure compliance. DataBank acquired Edge Hosting, LLC in September of 2017 providing additional expertise in the delivery of cloud solutions and managed services, especially for highly regulated industries.

Mark Houpt, Chief Information Security Officer, DataBank

Many healthcare organizations are hearing about Hybrid IT. From a compliance and security perspective, is Hybrid IT a good option for healthcare organizations?

Absolutely, HybridIT is a good option for healthcare organizations. Hybrid IT is not a new concept and what healthcare organizations may be surprised to find out is that they are probably already doing Hybrid IT to some degree.

To be clear, Hybrid IT is the concept that IT systems are are located in house and at a provider. Sometimes it is one entire application in house and another at the cloud provider. Sometimes the single application will span back from a cloud provider into the organization's data center. For example, the application may be at the provider, but the database is kept in house.

Regardless of the model you follow, security and compliance concerns are of paramount importance, especially within the healthcare industry. One of the key things to ensure in a hybrid set up is that the boundaries are clearly documented and responsibilities clearly defined. All too often, when I am working with healthcare organizations that are transitioning to a cloud provider, they think that the cloud provider assumes or takes over the responsibilities for security. This is not accurate and unfortunately, sometimes a healthcare organization has

to look at the fine print to see what the provider is actually doing for them. When working with a provider, ask the same questions you would ask of your internal teams. Assess the provider in the same manner, or even with more scrutiny, than your internal teams. Find the provider that will work with you and disclose this information easily and frequently. Look to a provider that can provide KPIs and other reporting functions so that you know the provider side of the hybrid model is working for you.

How do federal government mandates such as FISMA or FedRAMP affect HIPAA HITECH?

FISMA and FedRAMP only impact HIPAA HITECH if you are using, storing, processing, or qualifying federal government-owned data. If you are a healthcare provider that has no interaction with the federal government data, then compliance with those mandates is off your radar screen. Of course, compliance with HIPAA and HIPAA HITECH is never off your radar.

If you are hosting data owned by a federal agency, then compliance with HIPAA is astonishingly easy. Don't get me wrong, you can't simply assume HIPAA compliance if you are doing FISMA or FedRAMP. But the fact is that compliance with FISMA or FedRAMP requirements is more stringent in many areas than HIPAA. For example, the FedRAMP requires for use of two-factor

authentication and FedRAMP specifies the need for using encryption compliant with FIPS 140-2 where HIPAA does not specify down to the detail that FedRAMP does. Also, the continuous monitoring requirements of HIPAA are vague, simply stating that they are "required" to do so, whereas FedRAMP is specific about which controls and their frequency which can be daily, weekly, monthly, or quarterly. The one area a healthcare provider should certainly look to HIPAA over FISMA or FedRAMP is with breach notification. As all healthcare providers know, the DHHS is very prescriptive on this subject.

About the Author

Mark brings over 25 years of extensive information security and information technology experience in a wide range of industries and institutions. Mark holds an MS-ISA (Masters Information Security and Assurance), numerous security and technical certifications (CISSP, CEH, CHFI, Security +, Network+) and qualified for DoD IAT Level III, IAM Level III, IASAE Level II, CND Analyst, CND Infrastructure Support, CND Incident Responder, and CND Auditor positions and responsibilities. Mark is an expert in understanding and the interpretation of FedRAMP, HIPAA and PCI-DSS compliance requirements. Mark is an active member of ISC2, ASIS International, COMPTIA, IAPP, and ISACA, among other leading national and international security organizations.

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With the blue-tooth technology in place, clinical staff will receive updates in real time, eliminating the need for frequent check-ins.

counselors, who are available around the clock.

Create a better experience

Dr. Gupta agrees that healthcare providers need to meet escalating consumer demands by providing a more connected healthcare experience.

"There is a bell curve developing. The most connected patients that live in cities like San Francisco, Chicago and New York City are already starting to demand it. And, I think we're going to see an uptick now where even less tech-savvy patients are going to start looking at availability of health technology as an important factor when making decisions about which insurer and hospital system they go to," Dr. Gupta said.

To meet these needs, Dr. Gupta is counting on the fact that innovative technology can not only looking to make healthcare more convenient and efficient but more effective. More specifically, Dr. Gupta is working to develop a system that utilizes blue-tooth connected devices (blood pressure cuff, scale, pulse oximeter and activity tracker) that pulmonary hypertension patients can use at home to provide information to clinicians who can monitor their health status.

"There's a condition called pulmonary hypertension, which is basically a form of heart failure where the heart fails due to high pressure in the lung's arteries. Patients need to be on diuretics to control the swelling. So, helping these patients regulate their diuretics is really key," Dr. Gupta said. "These patients require high touch services. So, with the existing traditional systems, nurses or pharmacists need to manually call patients at set intervals. They check in to see what their weight and blood pressure is. The patients often record these measures on a piece of paper and then recite them. This is OK but there are times when this process fails, and these vulnerable patients can slip through the cracks."

With the blue-tooth technology in place, clinical staff will receive updates in real time, eliminating the need for frequent check-ins. Perhaps more importantly, though, the system leverages analytics to "identify trends in a patient's blood pressure, oxygen levels, activity, or weight that indicate they are proceeding in the direction toward heart failure based on pre-defined variables," Dr. Gupta said.

"Just being able to digitize this process, in and of itself, is valuable because it can ensure that patients are being properly monitored. Applying the algorithm to determine which direction patients are moving in, that's what really distinguishes the value of this technology," Dr. Gupta said. As such, the technology is expected to improve patient satisfaction, and hopefully demonstrate it can help reduce hospital readmissions and improve morbidity rates.

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HealthEC is a KLAS-recognized Population Health Management Company improving patient outcomes, managing costs and optimizing patient quality of life for independent physicians, provider organizations and health plans. An array of consulting services supplement in-house resources and develop or refine value-based care initiatives. Advanced analytics and workflow management tools guide patient care interventions for better care coordination and maximum reimbursement.

Arthur Kapoor, President and CEO, HealthEC

What technologies do healthcare organizations need to implement to succeed under value-based care?

The confluence of technology and Big Data in the digital age is transforming the health IT industry; and, as organizations transition to value-based models, population health management (PHM) tools are leading the charge. With simple-to-navigate, interactive dashboards, these platforms provide unparalleled opportunities for healthcare professionals to analyze data and formulate holistic strategies for improving patient outcomes and costs – particularly for the small amount of high-risk and rising-risk patients within a population who utilize the bulk of the resources.

Quite simply, PHM solutions are reinventing how provider organizations manage and administer services – achieving clinical and operational outcomes that were unheard of just five years ago.

Perhaps the most amazing function of certain PHM solutions is the ability to access data from any disparate system, in any setting and in most any format – thereby allowing organizations to aggregate, normalize and analyze decades of information using a single platform.

How does artificial intelligence impact health IT?

Artificial intelligence is not a new phenomenon, but the convergence of AI and Big Data is likely to transform medicine. Healthcare-based AI pairs deep learning with massive amounts of data from multiple sources, such as claims, hospital, health system, physician practice. and laboratory systems. The clinical and financial information can be aggregated and processed in meaningful ways by applying powerful algorithms to millions of data points.

AI, in turn, finds a correlation. The more information capable of being processed by machine -based-learning, the more insightful and beneficial are the applications that integrate and use the data for high performance analytics.

Essentially, AI recognizes and analyzes changing patterns in the patient's health and care, which gives physicians more time to react to and treat life-threatening diseases, for example.

How can the delivery of healthcare under a value-based care program be improved by analyzing social determinants of health?

Social determinants of health, which include factors such as a patient's socioeconomic status, physical environment and education, are an increasing consideration of organizations transitioning to new care delivery and reimbursement models. Using PHM solutions designed to automate patient interventions and activities, physicians along with care coordinators can tackle barriers blocking optimal health to improve patient outcomes and reduce costs.

For example, a provider armed with relevant data can help a diabetic patient address health literacy challenges. The diabetes educator can point to healthy, low- cost food choices during a grocery store walkthrough. The pharmacist can also meet with the patient to review the medication list and provide education, and bilingual support staff can bridge language gaps.

Improved patient engagement is an imperative for healthcare organizations. How do you envision healthcare organizations using smart devices and other consumer-facing tools to more fully engage patients in their care?

Some observers have noted anecdotally that we receive more communication from our dentists and veterinarians than our doctors! With that, a tremendous amount of action can be taken employing smart devices and other consumer-facing tools, including:
• Sending outbound messages such as e-reminders for upcoming appointments and suggesting preventive care services such as influenza vaccines.
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Having an app that provides and, at the same time, documents my review of the clinical guidelines and NIH (National Institutes of Health) stroke scale is essential.

Go-to guidance

In addition to assessing patient progress, artificial intelligence can also be used to help clinicians provide more effective care (see sidebar). For example, Marcus Scarbrough, MD, a hospitalist with Lawrence Memorial Hospital in Kansas, is using a mobile app that helps to prevent errors by providing clinicians with standardized, step-by-step guidance and decision support during critical healthcare events such as stroke, cardiac arrest and sepsis. The app provides step-by-step navigation similar to a GPS application to a sometimes 40 to 50 step algorithm followed by clinicians during a critical medical event. In essence, the app intelligently automates a clinical algorithm and offers a simple, intuitive way for providers to navigate that scenario for time critical diagnoses.

The app has proved especially helpful when dealing with stroke patients in inpatient units – because clinicians working in this environment typically do not experience these events very often, according to Scarbrough.

"When patients have a possible stroke in the inpatient unit it can be challenging because of the low frequency of this occurrence but the obviously high stakes. Having an app that provides and, at the same time, documents my review of the clinical guidelines and NIH (National Institutes of Health) stroke scale is essential. All the while, the timer is prompting and reminding me how much time we have to get the TPA (tissue plasminogen activator) in," Scarbrough said. "I don't want to be without the app anymore when I go on shift."`

The Very Real Benefits of Artificial Intelligence

According to Artificial Intelligence: Healthcare's New Nervous System, a study published by Accenture Consulting, key clinical health artificial intelligence applications can potentially create $150 billion in annual savings for the U.S. healthcare economy by 2026. The dollar amounts break down as follows:

$40 billion
Robot-assisted surgery

$20 billion
Virtual nursing assistants surgery

$18 billion
Administrative workflow assistance

$17 billion
Fraud detection

$16 billion
Dosage error reduction

$14 billion
Connected machines

$13 billion
Clinical trial participant identifier

$5 billion
Preliminary diagnosis

$3 billion
Automated image diagnosis

$2 billion
Cybersecurity

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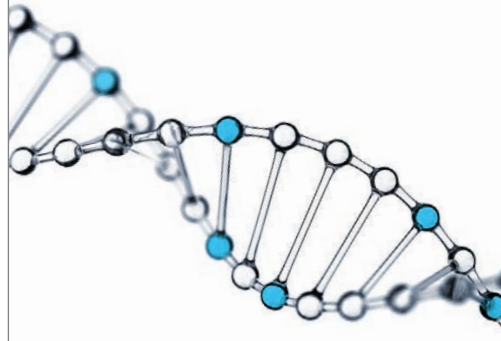
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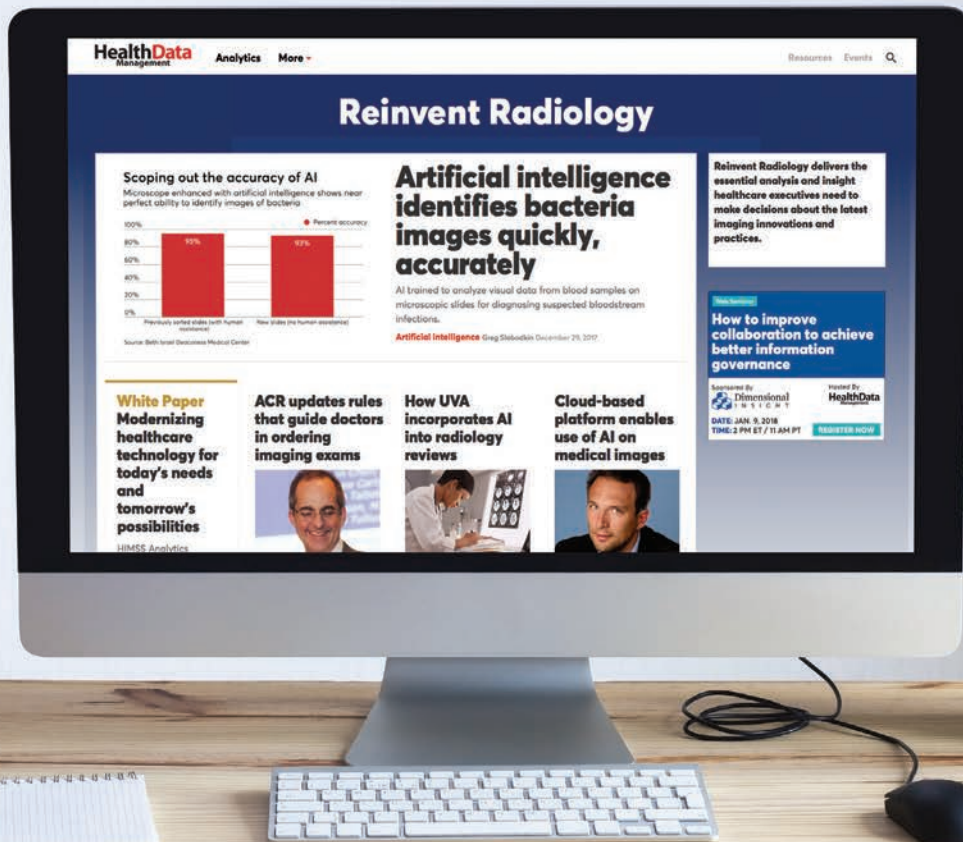
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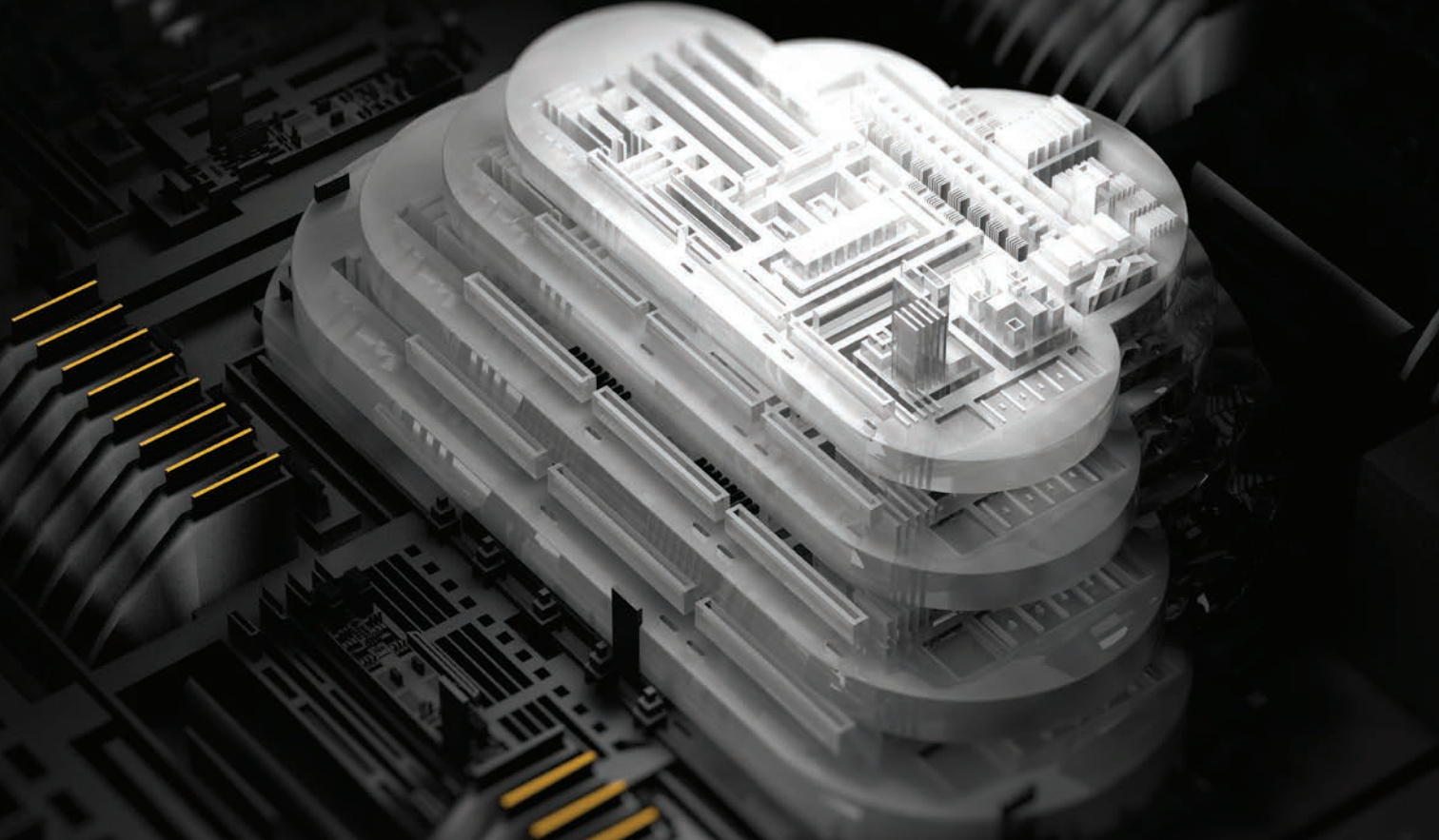
ANALYTICS RISE TO THE
CLOUD

Providers are embracing SaaS models to meet value demands.

By Greg Slabodkin

As healthcare organizations increasingly take on risk-based contracts, cloud-based analytics are enabling providers to break down data silos and gain visibility into care delivery provided across their enterprises in order to achieve better clinical outcomes at the best possible value.

By harnessing analytics in the cloud, these organizations are leveraging tools that help deliver actionable insights accessed through the Internet without having to invest in their own costly, on-premise infrastructure. This kind of software-as-

a-service ensures that providers are able to store, access and analyze a plethora of clinical, claims, risk stratification and other data resulting in best practices and strategies for quality improvement.

Gaining shared savings

Accountable Health Partners (AHP), a clinically integrated network of hospitals and physicians in Rochester, N.Y., has successfully moved to new reimbursement models using a cloud-based data repository and analytics platform from Arcadia Healthcare Solutions to support its population health management initiatives.

AHP's cloud-based population health platform analyzes the data to calculate hundreds of quality measures, cost utilization, risk scores and clinical gaps. As a result, its physicians make better decisions and support stronger collaborations with health plans on risk-based contracts and pay-for-performance quality programs.

According to LaRon Rowe, director of information management at AHP, the accountable care organization includes the University of Rochester Medical Center and more than 40 independent community primary care practices.

While the University of Rochester Med-

Image from gettyimages

ical Center has an Epic electronic health record system, Rowe points out that the more than 40 other practices use 10 different EHRs—which presented some technical challenges. However, AHP taps into the Arcadia platform in the cloud, enabling the ACO to centrally plan and drive clinical outcomes across their heterogeneous, geographically dispersed network of hospitals and rural independent physicians.

"One of the first things that AHP did was we entered into a shared-savings agreement with one of our commercial payers here in town," says Rowe. "We needed to not just measure cost but quality. We also have risk modeling built into the system that helps us come up with a risk score based on an algorithm, allowing our care managers to figure out who has the potential of being the sickest patients and to coordinate appropriate care."

Under a three-year Accountable Cost and Quality Arrangement (ACQA) with Excellus BlueCross BlueShield, quality measures are reported via the Arcadia analytics dashboard in an effort to share responsibility for providing coordinated care to patients to improve quality indicators—such as cancer screening rates, hypertension and diabetes control—and reduce unnecessary healthcare costs.

"It's a population health system that helped us as a network measure truly how we're doing on quality, aggregating data into a single source of truth that enables success across disparate practices," adds Rowe. "We're also able to integrate claims data from those local payers and bring it into a single system with clinical data."

He says AHP is also focused on optimization for its value-based contracts by improving its workflows to better capture quality measures, adding that when data is shared and presented in a transparent, workflow-relevant format, physicians trust the patient information seen at the point of care.

More than claims data

Beth Israel Deaconess Care Organization (BIDCO), a Massachusetts ACO and val-

ue-based hospital and physician network, has also implemented the Arcadia platform to enable real-time, cloud-based analytics aimed at improving population by integrating both clinical and claims data.

"What we're trying to do is get away from managing risk populations simply through claims data—which, in our case, has lagged anywhere from 90 to 150 days," says Bill Gillis, BIDCO's CIO.

BIDCO members, which include nine hospitals and about 2,600 physicians, currently operate more than 40 different EHR systems, and trying to integrate data from all the various hospitals and physician groups across Massachusetts was a daunting challenge. "We've got a very heterogeneous network from an EHR and clinical information system perspective," adds Gillis.

However, using Arcadia's EHR integration process and technology—called Data Connect—the organization has been able to extract the clinical data needed to meet risk contract requirements for quality outcomes and financial performance.

"The EHRs in our network now provide real-time data for us to actually do something with the analytics," Gillis says. "We get that data nightly in a batch process, and we pull it into our population health platform, which gets married with claims data as well as scheduling information and [admission, discharge and transfer] to give a real picture to our care teams of what's going on in the network with our patients."

"If you're a physician or hospital that's in a value-based contract, those insights are important to ensuring that health plans are measuring you in a timely manner and that all those important insights around quality are captured in their analytics so that your outcomes are not understated or misstated," says Eric Sullivan, senior vice president of innovation and data strategies at Inovalon, a cloud-based data analytics vendor focused on healthcare.

Gillis notes that BIDCO "has no actual internal infrastructure, aside from the desktops, PCs and network components in the closet—there are no servers here running databases; everything we have is up in the cloud." He asks: "Why would I own this infrastructure, build it and have to maintain it when I can go to the cloud?"

"As demand goes up and needs increase, being able to scale the analytics quickly is definitely something a cloud-based solution has helped us with versus an on-premise system," adds Rowe.

Sullivan agrees that scalability and configurability are major benefits of the cloud. "You as a provider don't have to download software and get updates—that automatically occurs," he says.

When it comes to cybersecurity, Gillis doesn't worry about data stored in the cloud. He recommends that providers go with a reputable cloud vendor that is a "known and trusted entity" in the industry.

Data become insights

In many ways, cloud computing is being transformed through artificial intelligence. It's no surprise that cloud giants like Amazon, Google, IBM and Microsoft are all making AI tools a part of their service offerings.

When it comes to AI, Rowe sees tremendous potential for machine learning and natural language processing to provide real-time analysis of clinical data and claims data for quicker insights. In particular, he observes, NLP holds great promise for unlocking the value of vast troves of unstructured data hidden within EHRs.

Cloud-based analytics vendor Inovalon is collaborating with the University of Maryland's Center for Health Information and Decision Systems as part of its ongoing development of NLP, machine learning and deep learning solutions. One goal is to advance the ability to perform ultra-high-speed analysis of unstructured data contained within raw clinical documentation, such as that found within EHRs.

"More than two-thirds of what is really clinically relevant is in unstructured text and uncodified fields," says Sullivan. "If you can have a machine scroll through a 300-page medical record in a fraction of a second and identify five potential places where the physician is indicating that they may have some diabetes complications, that is incredibly more efficient than having a human try to identify those areas."

"Artificial intelligence can be used to help with disease prediction, identify high-risk patients and preventative therapies," contends Véronique Grenon, vice

president of risk analytics of The Risk Authority Stanford, as well as the director of risk analytics for Stanford Health Care and Stanford Children's Health. "Risk management can also help with automating and optimizing hospital operations."

Identifying risk

The Risk Authority Stanford, created from the hospital risk management department serving the Stanford University School of Medicine, Stanford Health Care and Stanford Children's Health, has developed a platform for hospitals that leverages machine learning and NLP algorithms to classify millions of data points into categories that can identify key areas of risk.

TRA Stanford's platform, called Innovence Pulse, provides a suite of tools that deliver evidence-based data on demand to the hospital industry. The risk management software analyzes disparate data sets such as incident reports, loss runs, patient complaints and net patient revenue so users can manage expectations and claims in a given area, while taking actions to address issues and prevent future losses.

"It uses machine learning and natural language processing to read the unstructured free text of an event and then categorizes that event through our Stanford Risk Lexicon, which provides accurate risk classifications, descriptions and reports that make information actionable," says Randall Smith, product manager for Innovence Pulse. For instance, in the case of an infection that goes through a certain unit of a hospital, Smith says the platform can identify that emerging risk and enable the provider organization to intervene before it potentially affects more patients.

Beazley, an underwriter of hospital professional liability insurance, is using Innovence Pulse to identify trends in past claims and generate actionable data in real time to increase patient safety. Its claims database is one of the largest in the insurance industry and includes nearly 900,000 unique loss records dating back two decades. ∎

COLLABORATING ON
SECURITY

CIOs and CISOs work together as attack threats grow.

By Joseph Goedert

As cyberattacks against hospitals intensify, healthcare organizations are looking to boost security practices, and more are turning to chief information security officers to bolster defenses.

Healthcare IT executives say it's crucial for them to work closely and in coordination with CISOs to ensure cybersecurity strategies mesh effectively with an organization's IT initiatives.

Providers are realizing that the risks to their operations couldn't be higher, particularly as healthcare organizations have become dependent on electronic clinical records for continuity of care and operations.

That point was exemplified in January, when Hancock Health, a regional hospital in Indiana, paid a $55,000 ransom after a ransomware attack that infected the hospital's systems and hindered its operations. Attackers deployed SamSam ransomware that encrypted files, quickly affecting operations and forcing the hospital's IT staff to shut down the network and resort to pen and paper.

Even though the hospital had backed up its data, it opted to pay the ransom of four bitcoin, or $55,000. Hancock Health CEO Steve Long said that the files could have been recovered but restoring them would

have taken days or weeks.

The same variation of SamSam crippled information systems at Allscripts in January, knocking 1,500 healthcare providers off their cloud-based electronic health records systems and other applications for at least a week. Allscripts executives acknowledged the incursion and said services to all customers were restored about eight days after the attack at two of its data centers.

Security challenges have intensified because most facilities' "attack surface" has increased exponentially in the past couple of years; BI Intelligence, a research service, forecasts that the installed base of healthcare IoT devices (not including wearable devices such as fitness trackers) will grow from approximately 95 million in 2015 to 646 million in 2020. These medical devices are increasingly connected to hospital systems via the Internet, giving hackers more entryways to hospital networks.

In addition, providers are facing rising pressure to facilitate data sharing with other providers. Data exchange capabilities require a fine balancing act—systems must be open enough to share data with others, but that also provide more opportunities for hackers to break in, security experts note.

Because CISOs are focused on securing systems, they can pay all their attention to thwarting potential threats, and CIOs are giving them increased latitude in boosting security efforts. That's stimulating the move to close cooperation between CIOs and CISOs.

Attack surface expands

An organizationwide approach to security is crucial because vulnerabilities are not limited to—and not under the control of—systems that IT departments oversee, CISOs say. For example, various hospital departments have been buying "smart" or Internet-connected medical devices, with little or no input from IT departments, and many of them are poorly protected from a

data security standpoint, says Kevin Charest, CISO at Health Care Service Corp., which operates Blue Cross and Blue Shield plans in five states.

Increasingly, CIOs are looking for help with the broadening scope of security, and CISOs can bring a different view of the intersection of information technology and information security, Charest says. Because data and vulnerabilities are everywhere, CISOs tend to bring extreme caution to IT efforts because "our approach is zero trust. We have to assume folks we interact with may be compromised, so we need a mind-set for that challenge."

CISOs face rising security challenges at healthcare organizations, which in general lag far behind the sophistication of the cyber criminals that are trying to access their systems. The allure for hackers is twofold—hacked medical records have more black market value than financial records. Secondly, ransomware attacks are proving successful against healthcare organizations, because they're easily breached and often incentivized by operational pressures to get patient data and systems restored as quickly as possible.

Filling security gaps

While some provider organizations have robust and proactive data security programs in place, there's much room for improved security leadership at most organizations. A December 2017 survey of 323 providers and insurance payers conducted by Black Book, a research company serving the healthcare industry, found progress but also high levels of unpreparedness for growing cyber threats.

Some 84 percent of respondents from providers said their organizations did not have an enterprise leader for cybersecurity, and only 11 percent planned to install such a leader in 2018. Among surveyed payers, 31 percent had an established manager for cybersecurity, and another 44 percent were planning to have that position filled this year.

The survey also found that 54 percent

of respondents from all organizations do not regularly conduct data security risk assessments, and 39 percent do not regularly conduct penetration testing on firewalls. Further, nearly all C-suite officers participating in the survey acknowledged that cybersecurity and the threat of breaches are still not major talking points with their boards of directors.

CISOs at provider organizations believe the trend for investing money and resources in security is likely to grow as ransomware attacks and other cyber incidents gain notoriety, both within the industry and in the popular press. New security approaches must constantly be developed to counter not only new threats, but also discovered weaknesses in security, and evolving computing and device trends.

Data security is very much a "people process," and that can put CISOs and other security personnel in high-pressure positions, says Shari Lewison, chief information security officer at University of Iowa Hospitals and Clinics, an 811-bed public teaching facility.

A year ago, the organization started seeing malicious emails coming in at a rate not previously seen, and it created additional training mechanisms for employees to enable them to identify internal versus external emails.

In addition, the university extended the email subject line to highlight emails that were coming from external sources and quickly found that employee awareness of potential phishing emails increased dramatically. In December, University of Iowa Hospital and Clinics employees reported 8,000 suspicious emails to data security personnel. "Email cyber awareness rose, phishing incidents dropped by 75 percent, and the program costs were very low," Lewison says.

The organization also put in place a protection strategy of highly segmenting its networks, including creating a separate wireless guest network so patients or visitors with their own computing devices could use them without jeopardizing

hospital medical devices, information systems and networks. The hospital has tens of thousands of connected medical devices, including more than 1,500 IV pumps.

During 2015 and 2016, the university also implemented a security governance plan that included a device management approach to determine which devices could be brought into the hospital, as well as an annual review of device patching, according to Maia Hightower, MD, chief medical information officer at University of Iowa Hospitals and a clinical assistant professor. By 2017, University of Iowa Hospitals felt comfortable enough with its integration program and security posture to offer a bring-your-own-device program to employees.

New security initiatives at the organization this year will include next-generation firewalls on network borders to provide more visibility into what is going on in the networks and further determination of what devices can be allowed on networks, Lewison adds.

Getting along

CISOs and CIOs increasingly will need to work together to raise security awareness, as well as dollar amounts organizations spend to protect themselves.

For CISOs it is important to have a good relationship with the CIO because that's who fights for funds for the CISO, says Charest of Health Care Service Corp.

Kris Kusche, vice president of information services and chief information security officer and a biomedical engineer at Albany (N.Y.) Medical Center, reports not just to the CIO but to the chief compliance officer as well, and that gives him clout to a degree that other CISOs may not have in their organizations.

"I have the best of both worlds to have this wide portfolio and executive authority," he says. Other reporting relationships he's seen elsewhere include the quality assurance or legal departments. "The CISO has to be able to play across many roles and acquire a level of understanding of all clinical and business aspects of the organization."

University of Iowa Healthcare recently completed an annual risk assessment that found 20 percent improvement in the organization's overall security score compared with the previous year, and that increase was achieved largely with little new financial investment and with staff using existing security tools and processes. This underscores how tight relationships among the CIO, CISO and CMIO align the resources and messaging that deliver services in accordance with policies across the enterprise, she says. ∎

executive session

Brennan Spiegel, MD
Director, Health Services Research in Academic Affairs and
Clinical Transformation
Cedars-Sinai
Los Angeles

The Spiegel File

- Tufts University, BA in philosophy
- New York Medical College, MD
- University of California, Los Angeles School of Public Health, master's in health services
- Editor-in-Chief, *American Journal of Gastroenterology*
- Director of Health Services Research, Cedars-Sinai Health System

Interview by Fred Bazzoli

Pursuing a new reality for tech

Brennan Spiegel, MD, moved seamlessly from his role as a gastroenterologist to digital health maven by inventing a wearable device that helps clinicians answer a simple question—when can a patient start eating after surgery? Thus was born the AbStats monitor, a small device that listens to the gurgles of the intestines to determine if they've recovered enough after surgery to allow the patient to eat. That success has inspired Spiegel to look at other digital device approaches, most notably virtual reality and augmented reality, which he believes can help patients cope with pain without the addictive risk of opioids.

Spiegel doesn't just see gee-whiz gadgetry in digital health. "It's a platform to serve our patients," he says. "Health IT is less of a computer science or engineering science—it's more of a social science and a behavioral science. Technology development has become rather trivial—the hard part now is, how do we implement these technologies on the front lines of care?"

On digital health's value

Digital technology allows us to go beyond the four walls of the hospital. Patients spend most of their lives far away from the hospital—if we're really going to engage them, we have to reach out to where they are.

On innovation

In my role, I report to the senior vice president of clinical transformation and also the dean of our faculty. That recognizes that my role spans both research and operations. Our research needs to support the learning health system cycle—research is great but what we discover should not just stop there; it should be inserted back into the health system to move the needle.

On value-based care

The incentives of payment reform are being aligned so we get paid for doing high-quality care, and digital health and informatics are right at the heart of that.

On hype surrounding AR/VR

Much depends on the use case; on the Gartner hype cycle it's moving back up the plateau of productivity—it seems like it's ready to be implemented. Our recent research suggests VR may be more effective at reducing patient pain than opioids, with low risk of addictive side effects. The question is, how do we get it into the hands of patients and into the clinic?

We've also recently published research that there's not yet sufficient evidence that wearable biosensors improve the value of healthcare—that doesn't mean it won't happen in the future. ■

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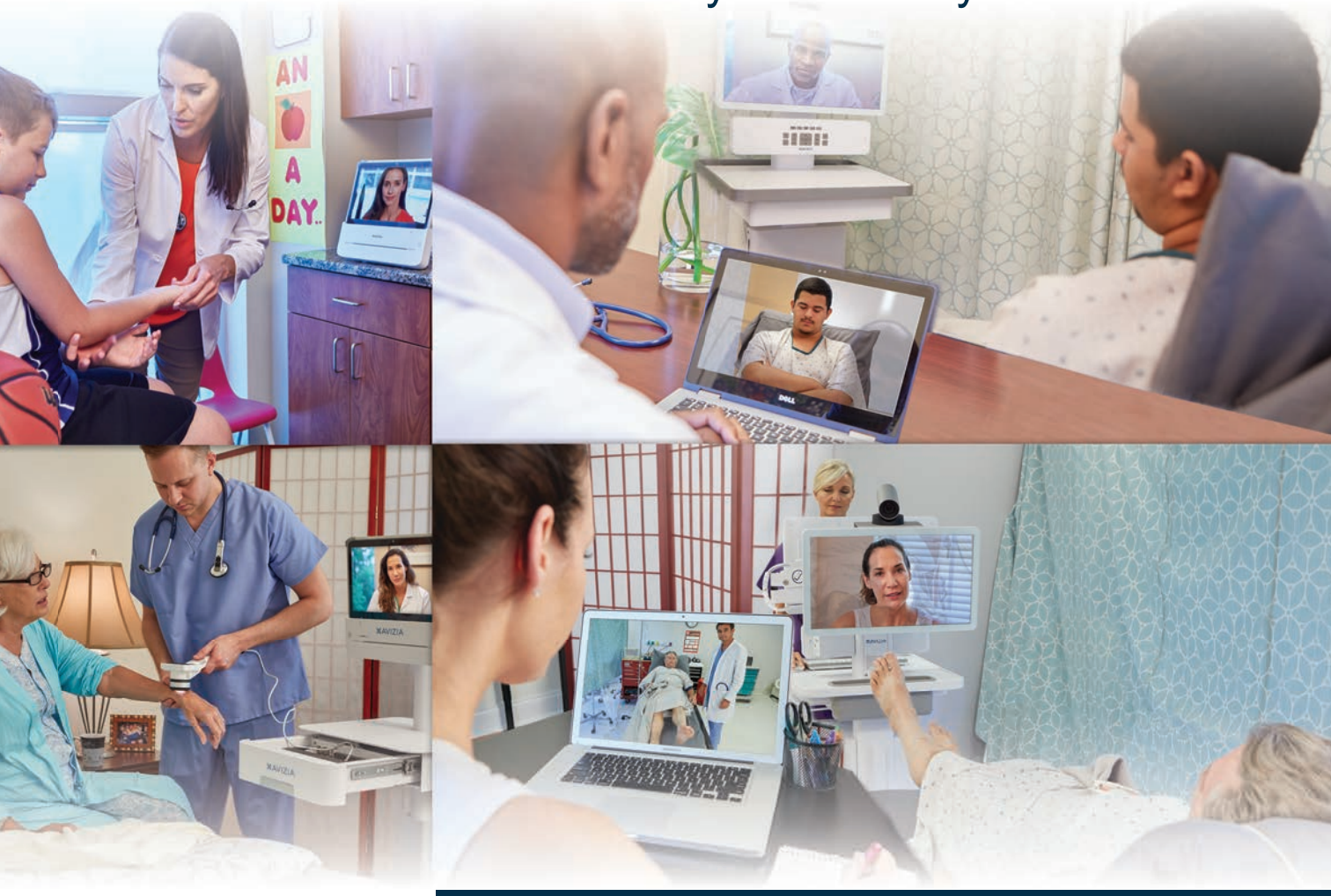
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