

Artificial Intelligence in Healthcare: The Current, Compelling Wave of Interest

By Lea E. Radick

Self-driving cars. Voice-powered personal assistants on our smartphones. Suggested searches and tagging on social media platforms. These innovations are all examples of artificial intelligence—a branch of computer science dealing with the simulation of intelligent behavior in computers, or the capability of a machine to imitate intelligent human behavior.

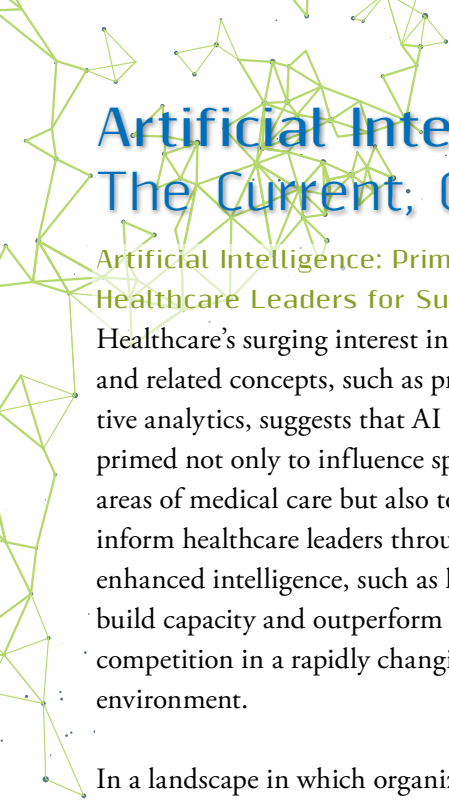
Although just a small portion of the healthcare field is using AI now, its application is poised to increase, according to a 2017 study released by HIMSS Analytics, a healthcare research and advisory firm for healthcare delivery organizations.

The *HIMSS Analytics HIT Market Indicator: Artificial Intelligence* study, released April 11, found that of 85 healthcare organization survey respondents, 24.7 percent plan to leverage AI in the next three to five years, with another 23.5 percent planning to do so even sooner.

A variety of factors are catalyzing the adoption of AI in healthcare, according to AI experts and healthcare providers, such as government regulations, societal influences, economics, and the dual promises of potential access to a lot of data and greater computing power.

Keith J. Dreyer, DO, PhD, vice chairman, radiology, Massachusetts General Hospital, Boston, and chief data science officer, Partners HealthCare, Boston, says AI innovation occurring in the consumer space over the past five years “will translate well to healthcare,” and he is not alone in that assessment.

Roger Smith, PhD, chief technology officer, Florida Hospital Nicholson Center, Celebration, says AI has been promising intelligent machines and computer programs for at least 50 years, but has been delivering on that promise only incrementally. However, he thinks the current wave of AI interest is different. “AI has gotten a lot smarter really fast in the past 10 years or so. The technology is just stronger now and therefore more promising,” he says.



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Artificial Intelligence: Priming Healthcare Leaders for Success

Healthcare's surging interest in AI and related concepts, such as predictive analytics, suggests that AI is primed not only to influence specific areas of medical care but also to help inform healthcare leaders through enhanced intelligence, such as how to build capacity and outperform the competition in a rapidly changing environment.

In a landscape in which organizations are operating with shrinking budgets and fewer resources and staff, AI could help reduce costs and increase efficiency, says Lee Kim, JD, FHIMSS, director, privacy and security, HIMSS North America, Arlington, Va.

"Artificial intelligence is a tool to help leverage the assets that you have and optimize the way business and clinical work is done," says Kim, who holds certifications in cybersecurity and information privacy. She adds that leveraging AI to improve clinical outcomes and bottom-line profitability could not only help hospitals stay afloat but make them more attractive targets for mergers and acquisitions.

One application of AI is intelligence analysis, which allows for collecting and vetting of information for trustworthiness and reliability, and evaluating information for both meaning and relevancy to what the human user of AI may be researching or studying, Kim explains.

Predictive analysis—a type of intelligence analysis—goes a step further by helping the user of AI discern a pattern from those vetted pieces of information. Based on the data points gathered through intelligence analysis, the end user of AI can extrapolate predictive analysis to gain insight into the future.

The objective of intelligence analysis, and predictive analysis in particular, is to determine something that's action oriented or a recommendation for the future that one should do or that one foresees, Kim explains.

To help make these analyses and predictions, AI can use a huge amount of a special kind of information—known as big data—plucked from a massive data set.

Because big data is so huge, it requires specific technology and analytical methods to make use of that information to transform it into something valuable, Kim says.

She describes the relationship between big data and artificial intelligence as that between a nail and a hammer: AI is the tool—the hammer—needed

to put big data—the nail—in its place to fix a problem. By itself, big data is simply a massive amount of information. Unless it is analyzed, one cannot determine the meaning or relevance of the data, she says.

"Healthcare organizations that can do more with the vast amounts of data that they've collected, and are collecting daily, will be more successful in providing the right care to the right patient at the right time, and also be able to eliminate unnecessary costs that come with healthcare," says Ian E. Hoffberg, manager, healthcare information systems, HIMSS North America, Arlington, Va.

"To stay competitive, you need to optimize the AI machine environment," Hoffberg adds. For example, when developing an AI model and algorithms, it's important that the outcomes AI provides are trustworthy. This begins with identifying the right patient populations that will provide the explicit feedback you seek regarding a health system's high-risk population.

Also important is optimizing the AI technology to provide feedback on

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factors associated with the patient population, such as socioeconomic and geographic factors, and to adjust AI models accordingly.

“As you’re able to go through those steps and then adjust appropriately, you’re going to get the highest level of success out of your AI commission,” Hoffberg says.

Stephen Pratt, CEO, Noodle.ai, San Francisco, anticipates the divide will increase between hospitals or healthcare systems that are using AI and other forms of advanced analytics and those that aren’t, and that the organizations using supercomputing technology or learning algorithms to run their systems are going to outperform those using spreadsheets on their laptops.

However, Pratt sees most hospitals’ administrations lagging behind other professions and industries in their use of analytics when it comes to running their operations. “I encourage hospital administrations to step up their game when it comes to the use of advanced analytics and learning algorithms,” he says.

Areas of Influence

According to the HIMSS Analytics study, 24 percent of the respondents ranked aspects of population health, such as chronic disease management, as areas where AI will have the greatest initial impact, followed by clinical decision support and patient diagnosis (20 percent for each), precision

medicine (14 percent), hospital/physician workflow (8 percent), security (6 percent), revenue cycle (2 percent) and drug discovery (1 percent), with 5 percent unsure as to where it will have the greatest impact.

Larry J. Goodman, MD, CEO, Rush University Medical Center, Chicago, sees AI having the largest impact in healthcare in the areas of population health and chronic disease management, and in providing predictive analytics to anticipate such things as disease outbreaks or sepsis.

For example, Rush has been using an AI system to monitor the symptoms of ED patients to determine if a certain array of symptoms occurs at a higher frequency. If the system detects that more people are presenting with flu symptoms, that spike in the rate tells hospital staff to consider culturing patients for the flu now, rather than waiting for the health department or other source to describe disease activity.

Rush’s AI system also looks at charts and notes entered into EHRs and includes that information in its

findings along with symptoms reported by laboratory tests. This also can be used to detect early findings consistent with bioterrorism, radiation illnesses or other uncommon disease symptoms.

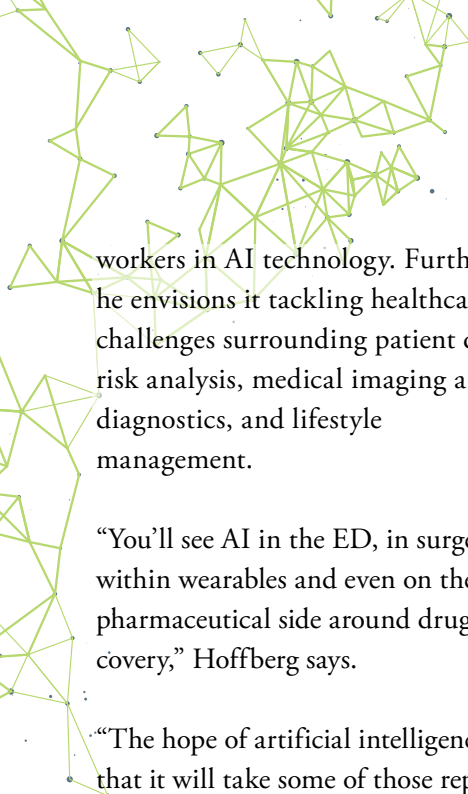
For example, if a patient in the ICU is exhibiting early signs of sepsis, her vital signs, which are recorded regularly in her chart, could alert the nurse or physician on the floor. “By identifying that early, we could have a much better impact on the disease process than waiting for it to present itself in the more traditional timing,” he says.

Hoffberg sees AI as making the biggest advancements in healthcare in the realm of pattern recognition. “AI could potentially phase out the role of a radiologist,” he says. Given the amount of data that exists in healthcare, AI has the potential to recognize patterns with 95 percent accuracy, he says.

Hoffberg also sees AI potentially replacing workflow processes and even positions in healthcare systems, or ushering in the need to train

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workers in AI technology. Further, he envisions it tackling healthcare challenges surrounding patient data, risk analysis, medical imaging and diagnostics, and lifestyle management.

“You’ll see AI in the ED, in surgery, within wearables and even on the pharmaceutical side around drug discovery,” Hoffberg says.

“The hope of artificial intelligence is that it will take some of those repetitive tasks out of the equation,” Kim says, noting that AI will likely be a “big boon” for patient safety and better clinical outcomes.

Pratt of Noodle.ai, which provides artificial intelligence and AI applications for large enterprises, including a university hospital system, believes hospital operations is one area in which AI could “drive enormous benefit to the system,” particularly through predicting clinician staffing needs. “AI and machine learning can do a much better job of predicting patient arrival rates,” he says.

Another area of healthcare that could benefit from the use of AI is pharmaceutical inventory. “There’s a lot of waste right now of pharmaceuticals that expire, and so getting that right is important,” Pratt says.

He also agrees that AI could benefit healthcare in the area of population health, especially with regard to providing the right kind of care to

patients with chronic conditions, such as diabetes.

When talking about artificial intelligence, people tend to focus on images and text, or “unstructured data,” according to Pratt. However, he thinks more AI innovations will derive from “structured data,” or numbers.

Learning algorithms that analyze socioeconomic factors about a person can help find patterns and thereby determine their health and treatment.

“It’s not as sexy, but I think it’s where true transformation of the healthcare system will happen, because it can allow you to serve more patients, reduce the cost of healthcare, allocate care to more people and identify where care is more urgently needed in the population. Most of that analysis comes from analyzing numbers and trends and external factors,” he says.

Surgical Simulation, Data Mining and Robots

Smith of the Florida Hospital Nicholson Center—an immersive medical training and education center for practicing clinicians—notes three areas in which AI will begin making a difference sooner rather

than later: training, data mining and surgical robotics, which could one day replace human surgical assistants.

Smith believes the biggest area of impact in healthcare is patient diagnosis, specifically via a website that allows patients to describe their symptoms, their conditions and the drugs they are taking, and then provides them with the same advice most doctors would give.

“I think you could program a computer so that it’s the first line of defense when somebody is ill,” Smith says, adding, “An AI-driven website could guide you through that and give you the most likely situation that you’re experiencing.”

However, Pratt thinks the healthcare field should steer clear of training “chatbots” to talk to patients over the internet and provide medical advice. “There are some very high-profile failures of those kinds of things,” he says.

Nevertheless, Smith believes people are ready to start talking to computers. “They already are,” he says.

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“When you have an issue and you go on the internet and you ask some of the sites to give you information, that’s you asking the computer to help diagnose yourself.”

In a related arena, minimally invasive surgical systems powered by robotic technology could begin replacing human surgical assistants by programming into the robot what was previously done by a human, Smith explains.

At the Nicholson Center, Smith and his team are developing an AI-assisted simulator to use in surgical training. This simulator would provide the trainee with real-time intelligent guidance during an exercise rather than calculating a score at the end that tells the students what they did right or wrong.

The center also is developing a virtual world that looks like a robotic operating room for surgeons to practice communication protocols that they use with other members of the surgical team. The automated team members are programmed with artificial intelligence to know whether the user is following the protocol—similar to the AI used in online game characters, Smith explains.

Data mining is another AI application that could start making a difference in healthcare by accessing knowledge about relevant surgeries that reside in the cloud and downloading that information onto a robot that’s being

used for a particular surgery. This is more efficient and practical than storing data about thousands of unrelated surgeries on a robot.

Smith believes a smarter healthcare system can be created by organizing the knowledge it acquires so that it can be delivered to a patient in an efficient, targeted manner. “We’re looking forward to when that information can get encoded so the AI can then organize it,” he says.

Large-Scale Deployment of Narrow AI

Dreyer looks at the use of AI in healthcare in two ways: performing activities that humans do but with greater consistency and quality, and providing new solutions or activities that humans can’t perform because of the required analysis of massive amounts of data.

Most AI deployed in 2017 is meant to solve a specific problem, which Dreyer calls narrow AI, rather than be applied generally.

The problem with narrow AI, he explains, is that to use such AI applications on a large scale, you need a platform on which to deploy them.

This need for the massive and rapid proliferation of narrow AI applications is one reason that two Harvard University-affiliated teaching hospitals, MGH and Brigham and Women’s Hospital, also in Boston, created the Center for Clinical Data Science in 2016 and chose to partner with an AI-capable vendor. A cross-functional and cross-institutional group of clinicians, researchers, data scientists, product developers and translational experts, the center is working to build a smart healthcare delivery system through the creation of machine learning tools and services.

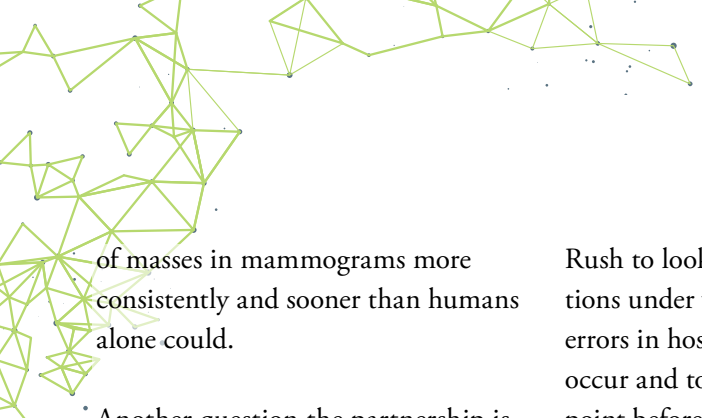
One of the goals of the partnership with the vendor is to develop a platform that will absorb massive amounts of data to train AI models and put those models back into the workflow of clinicians’ decision-making processes.

Over the long term, Dreyer sees these AI applications benefiting the healthcare field in endless ways. One early endeavor that the partnership is looking at is imaging.

Specifically, the partnership is trying to discover whether it can use computers to aid humans in the detection

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Massachusetts General Hospital



of masses in mammograms more consistently and sooner than humans alone could.

Another question the partnership is hoping to solve is whether it can more accurately predict the longevity of patients' lives using AI along with CT scans, for example, and, based on the prediction, guide patients who will need follow-up or closer monitoring into population health registries.

He sees these benefits of AI happening through collaboration with a consumer-oriented industry. "That clearly provides a competitive advantage to those healthcare providers that do [AI] first or are involved in that activity first," he says.

Anticipating Outbreaks

Rush has been using its AI system to look for more exotic illnesses, such as severe acute respiratory syndrome, or SARS—a very aggressive respiratory infection that has a high mortality rate, or the Zika and Ebola viruses.

Rush can take patient findings such as medical history and information about travel to an area that has the Ebola virus, for example, and plug them into other EDs in the geographic area to screen patients who also have recently traveled to places with the virus.

AI will become even more valuable with predictive analytics, Goodman says. Predictive analytics enables

Rush to look at the kinds of conditions under which certain types of errors in hospitals are more likely to occur and to identify the actual error point before it even occurs.

Goodman says a key goal of Rush's new CIO/Senior Vice President, Shafiq Rab, is to make connections between care providers and patients smoother and better. With the AI system collecting and manipulating data, care providers can increase the time they spend with a patient.

AI also can provide physicians and other care providers with tools to make better and safer decisions, he explains.

"Many physicians see the EMR taking them away from direct patient care. AI, ideally, might increase the time physicians spend with patients and other members of the healthcare team, reduce errors, lead to earlier diagnoses and finally contribute to the goal of providing both high-tech and high-touch care," Goodman says.

The next step for AI in detecting exotic diseases is for the software to incorporate medical records, lab reports and news from around the world on disease outbreaks into its

screening system to look for relevant new outbreaks and notify ED intake staffs to look out for certain symptoms in people coming from the specified geographical locations.

While this capability does not yet exist, Goodman says given that systems can read and incorporate data, it shouldn't be too far away. This application of AI might assist in at least identifying a group of people who should be screened.

He also sees AI as aiding new approaches to diagnosis and treatment for diseases such as cancer by combining data regarding the genetic analysis of a person with clinical symptoms. This combination of genetic properties and clinical symptoms in response to therapies can help clinicians identify people whose cancer can be explained with some certainty in terms of their likelihood of responding to a therapy, and why.

Considerations and Concerns

Despite the clear benefits of an artificial intelligence-influenced healthcare delivery environment, Kim acknowledges there are concerns regarding the extent to which AI is adopted

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and to which AI may take over, or otherwise replace, human beings.

“Should artificial intelligence take the place of humans? If so, then to what extent?” Kim asks.

She says a balance must be struck between AI’s capability in augmenting healthcare operations and human intelligence, intuition, creativity and judgment.

“A lot of folks would say that medicine is an art as well as a science and sometimes it’s that human element that artificial intelligence can’t replace,” Kim says. “I don’t think people would want a machine making the decision on something that’s critical to saving or sustaining a human life without that human check and balance.”

Hoffberg says one of the biggest concerns around AI is that physicians and health system executives may not yet be able to trust AI.

“It’s about getting that provider buy-in, and it’s a cultural issue,” he says, adding that physicians, managers, the executive team and health system employees all must trust the output or advice that AI and machine learning provide.

“That’s going to come with more viable business cases as this grows and it gets more traction in the industry,” he says.

Dreyer says unintended consequences always accompany new technology, which is why MGH and BWH created the Center for Clinical Data Science—to answer questions surrounding ethical issues associated with AI, as well as legal and regulatory issues. There also are staffing adjustments to consider, such as educating the workforce and modifying jobs.

“This is new technology for healthcare providers that they’re going to have to be able to accommodate and embrace,” he says.

Perceived Opportunities

Although Hoffberg calls for a balanced approach to how healthcare organizations use AI, he anticipates seeing the healthcare field pivot toward using AI as the core processing technology to help organizations obtain and sift through their data.

Overall, Pratt sees AI benefiting healthcare through the amplification of human intelligence as opposed to replacing humans.

Humans are not good probabilistic thinkers because we are subject to a variety of cognitive biases, Pratt explains. “It’s in helping overcome

these cognitive biases that AI can help improve health systems overall,” he says.

“The hospital of the future will have tens or hundreds of algorithms helping to constantly optimize the operations so that there can be better patient care, reduced cost and more satisfied patients,” he adds.

Smith thinks AI will make healthcare more accessible, accurate and complete. “Once we get past the initial cost of creating and installing [AI], the hope is that it will make care less expensive.”

“I hope that, at the end of the day, we never lose sight of the best interests and wishes of patients and their families. We need to keep in mind that artificial intelligence—and machines—are tools. The wishes and decisions of people should matter more than that of artificial intelligence and machines,” Kim says.

Healthcare is a unique industry, she notes. “We still need people to deliver the care and be the final arbiter of what is best.”

Lea E. Radick is a writer with Healthcare Executive.

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