AI

AI and Care Delivery

Emerging opportunities for artificial intelligence to transform how care is delivered

American Hospital Association™
Advancing Health in America

AHA CENTER FOR HEALTH INNOVATION | MARKET INSIGHTS

Executive Summary

AI's Potential for Care Delivery

Improving outcomes and reducing costs. That is the value that hospitals and health systems across the country strive to deliver to their patients and their communities each and every day. However, to do that in today's health care environment can be challenging for hospitals of all sizes and types.

Many hospitals and health systems increasingly are considering new technologies powered by artificial intelligence (AI) and machine learning (ML) to help them meet that challenge. Advocates say AI technologies can improve outcomes and lower costs at each stage of the care cycle from prevention to treatment.

AI does this by using data for:

- **PREVENTION:** Identify patients at risk of disease.
- **DETECTION:** Detect changes in patients' medical conditions.
- **DIAGNOSIS:** Enable more accurate and faster diagnoses.
- **TREATMENT:** Customize treatment plans for individual patients.

But, to realize this promise, hospital and health system leaders need to build a powerful clinical AI infrastructure of people, policies, resources and technology. They also need to overcome the barriers of clinician concerns about AI and consumer hesitancy about AI applications in health care.

This Market Insights report from the American Hospital Association's Center for Health Innovation explores the use of AI as a clinical decision support tool in four stages of the care cycle and walks hospital and health system leaders through the why and how of successfully integrating AI-powered technologies into their care delivery operations to improve outcomes and lower costs. The AHA Center for Health Innovation thanks everyone for their contributions to this report and to the series of related practical AI resources now available to hospitals and health systems.

Download the following AI resources from the AHA Center for Health Innovation

- AI Care Delivery Discussion Guide
- AI and the Health Care Workforce Market Insights report
- Surveying the AI Health Care Landscape Market Insights report
- AI Vendor Selection Tips
- AI Workforce Discussion Guide
- AI Scenario Planning

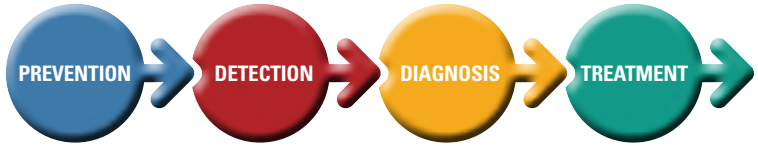
Reimagining Care Delivery with AI Technologies

New technologies powered by AI have the potential to help hospitals and health systems improve patient experience and outcomes by reducing administrative tasks and mining and processing medical information for faster and more accurate decisions, and making it easier for staff to do what they do best — problem solving, critical thinking and having conversations with patients.

Hospitals and health systems across the country increasingly are responsible for the health of patients at every point along the continuum of care. As the health hubs in their respective communities, their goal is to improve the health of the population they serve by delivering high-quality, accessible and affordable health care. Hospitals and health systems want — and patients and payers expect — the best possible outcomes at the lowest possible cost: in a word, value.

How hospitals and health systems can succeed at preventing, detecting, diagnosing and treating disease grows more challenging each day as the patient population ages, as more people suffer from chronic diseases, as cost pressures build and as the availability of clinical resources tightens.

While AI's success hinges on the expertise of the clinicians and health professionals who use it, it can significantly ease pressure on resources and increase efficiencies. Technologies powered by AI, machine learning and robotic process automation have the potential to improve outcomes and patient experience and to control costs through timely and precise interventions, greater productivity and a reduction in unnecessary utilization.



This Market Insights report from the AHA Center for Health Innovation shows the use of AI as a clinical decision support tool in four stages of the care cycle. This report also identifies the infrastructure that hospitals and health systems need to take advantage of AI technologies in each stage of the care cycle and outlines strategies and tactics to overcome common barriers to AI adoption in clinical settings.

For the sake of brevity, this report refers to AI, ML and RPA collectively as AI.

PRO TIP

AI can have the biggest impact in prevention and wellness, because clinicians play an essential role in promoting healthier lifestyles and preventing disease.

Know the Difference: AI, ML, RPA

To know what vendors are selling and what resources are needed to make an AI model work, hospital and health system leaders should know the differences among artificial intelligence, machine learning and robotic process automation.

Artificial intelligence (AI) is technology that mimics the human thought process. Natural language processing (NLP) is the ability of a computer program to understand human language as it is spoken. NLP is a component of AI.

Machine learning (ML) is a type of AI that learns and improves as it processes more data.

Robotic process automation (RPA) is the use of software to handle high-volume, repeatable tasks that previously required humans to perform. In this report, we are looking at intelligent automation that combines RPA with AI for solutions that either directly assist people in the performance of tasks or automate those tasks entirely.

About this Report *The AHA Center for Health Innovation developed this Market Insights report for hospital and health system executives who are working to integrate AI into care delivery to drive more value for their organizations, their staff and, most importantly, for their patients and communities. This report is based on information and insights from interviews with a panel of health care AI experts and hospital and health system leaders, who are identified on Page 11. The report also is based on reviews of published health care reports, surveys, articles and research on AI. A complete list of the resource materials is on Page 12. The AHA Center for Health Innovation thanks everyone for their contributions to this report.*

Using AI to PREVENT Disease and Improve Health

Preventive care to keep people healthy and access to prompt treatment when necessary are key to limiting increases in health care spending. AI technologies can help hospitals and health systems keep people in their communities healthy and detect disease at an earlier stage, according to the expert panel and published research. AI has the ability to mine disparate and voluminous sources of information in real time, identify patterns and connections in the data collected and generate insights for clinicians who can act on those insights in conjunction with their patients.

AI is already being used to more accurately detect diseases at an earlier stage, but can also enable more precise and personalized treatment. That means hospitals and health systems can use AI to prevent disease or the progression of medical conditions in several key areas:

- **Vaccines/Immunizations:** Identifying patients who need seasonal, maintenance or age-based vaccines to immunize them from viruses that can lead to disease like the flu, pneumonia, cervical cancer, shingles and chicken pox or to immunize them from an outbreak of a disease like measles or whooping cough.

- **Genetics:** Identifying patients who are genetically predisposed directly, or in combination with other medical conditions, to diseases like cancer, diabetes or heart disease and encouraging them to take appropriate medical or lifestyle actions to prevent these diseases from occurring.

- **Chronic Disease:** Identifying patients who are at risk for chronic disease and who could benefit from routine health and wellness screenings and visits.

- **Social Determinants:** Identifying patients who are at risk for certain diseases because of one or more social determinants of health (SDOH) and then targeting interventions to mitigate their impact on patients' health.

- **Disease Patterns:** Identifying new disease patterns or disease progression patterns to anticipate and develop interventions to prevent those patterns from becoming widespread. With the data instantly at their fingertips, physicians can provide on the spot care. Beyond that, AI can provide insights that are predictive in nature — pinpointing individuals who are more likely to respond to specific treatments, or who could develop disease in the near future.

AI technology can take information and data from multiple sources — patient encounters, in-home evaluations of enrollees by health plans, patients' medication use tracking by pharmacies and publicly reported demographic data — and analyze them to inform patient care and to improve population health outcomes.

PRO TIP

Screening individuals for social determinants of health and having data on social determinants of health are not the same as understanding why those determinants become risks. AI can hone in on the key social determinants relevant to a given patient.

Using AI to DETECT Changes in Patients' Health Status

Clinicians' knowledge of a particular disease state is based on their medical training, ongoing medical education and experience from treating patients. AI's knowledge of the same disease state is based on its programming, its learning algorithm and every clinician's experience from treating every patient with the same signs, symptoms, diagnoses, treatments and outcomes. However, ideal data sets for AI have accepted criterion standards that allow AI algorithms to "learn" within the data. Most clinical data are recorded in limited, broad categorizations that omit specificity and are also limited by potentially biased sampling.

With appropriate data, AI can detect and connect signs or symptoms with other signs or symptoms that humans may be unable to. Rather than waiting for symptomatic escalation, many medical events will be detected and intercepted upstream.

As a result, AI can give hospitals and health systems the ability to:

- **Remotely monitor patients suffering from a chronic disease.** In-home sensors or wearable technologies can feed data to AI-powered software that collects, detects and reports a change in a patient's condition, signaling the start of deteriorating health status that could be prevented by a personalized message and an immediate intervention.

- **Predict patients at risk for readmission and remotely monitor patients discharged from the hospital.** AI can analyze clinical data from a patient's electronic health record and SDOH information — for instance, access to a pharmacy, access to transportation, having food in the pantry — to calculate the patient's risk of readmission within 30 days of being discharged. The hospital can then use that information to pinpoint and mitigate specific readmission risk factors.

  In-home sensors or wearable technologies can feed data to AI-powered software that collects, detects and reports a change in a patient's recovery, signaling a potential setback and readmission to the hospital that could be avoided by immediate intervention.

- **Predict patients at risk for an adverse event in the hospital.** Patient monitoring technology and sensors use AI to track real-time health data, including heart rate, respiration rate, sleep cycles, stress levels and movement. AI can analyze heart and respiratory factors to predict cardiac or respiratory arrest risk and factors related to falls, pressure ulcers and other adverse events for early intervention.

Early and immediate interventions based on the detection and connection of risk factors that predict a change in a patient's medical condition can produce better clinical outcomes. It also can reduce costs by eliminating the need for more expensive and intensive interventions when a patient's condition worsens.

INSIGHT

AI gives hospitals and health systems the ability to see patterns and make predictions about patients' health, mortality, readmission and sepsis risks that they couldn't see without AI.

61%

of patients say AI can improve follow-up for patients with chronic conditions

Source:npj | Digital Medicine, June 14, 2019

| DEEP DIVE |

Inpatient Monitoring of Patients at Risk for Sepsis

For every hour of delayed diagnosis, sepsis mortality increases up to 8%. AI can analyze clinical data in real time of patients in emergency departments (EDs), on general medical-surgical floors, observation units or intensive care units for signs and symptoms of sepsis. At the moment there is sufficient data suggesting that a patient has sepsis, it sends a signal to the bedside clinician who can intervene with appropriate antibiotics and fluids to reduce sepsis mortality rates.

HCA Healthcare has used its Sepsis Prediction and Optimization of Therapy (SPOT) tool with 2.5 million patients, and together with the use of evidence-based clinical interventions, has helped save an estimated 8,000 lives in the last five years.

Using AI to DIAGNOSE Patients More Accurately and Quickly

Diagnosis of disease using deep-learning algorithms, a form of AI, holds enormous potential. Researchers from the NHS Foundation Trust in the United Kingdom conducted a meta-analysis of 25 different peer-reviewed studies that compared the ability of AI to diagnose a disease with the ability of clinicians to diagnose the same disease through medical imaging. This review, published in *The Lancet Digital Health*, is the first to systematically compare the diagnostic accuracy of all deep-learning models against health care professionals using medical imaging to date. Within a handful of high-quality studies, researchers found that deep learning could indeed detect diseases ranging from cancers to eye diseases as accurately as health professionals.

More studies considering the integration of such algorithms in real-world settings are needed, especially in regular clinical practice where diagnostic decisions made by an AI algorithm are acted upon to see what then happens to outcomes that really matter to patients, like timely treatment, time to discharge from hospital or even survival rates. To validate a deep learning system for clinical implementation would require multi-institutional collaboration and large datasets.

Members of the expert panel assembled for this report agreed that AI won't replace clinicians inside a hospital or health system whose job it is to diagnose patients. Instead, AI can help clinicians quickly and more accurately diagnose a patient's condition. Augmented intelligence focuses on AI's assistive role, emphasizing that its design enhances human intelligence rather than replaces it. Examples include using AI to:

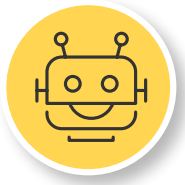
- **Compare** patients' signs and symptoms against known disease states.
- **Order** the most appropriate diagnostic tests for patients based on their conditions.
- **Guide** radiology workflow to prioritize exams with acute conditions.
- **Sift** through patients' records from disparate sources to identify missing signs and symptoms that could assist with an accurate diagnosis.
- **Assist** physicians in diagnosing complex or rare conditions.
- **Identify** at-risk patients to deploy scarce resources.
- **Automate image interpretation** to supplement and enhance the use of medical images to deliver high-quality patient care across a wide variety of diseases and organ groups.

Engaging Patients with AI Apps for Faster Diagnoses

Companies are giving consumers AI tools to better manage their health with self-monitoring apps and wearables to help patients understand their symptoms and when to treat with over-the-counter remedies, call or visit the doctor's office or seek emergency care. Hospitals and health systems can use these tools to bridge the gap between provider and patient by engaging with patients remotely and obtaining actionable information prior to patient encounters in health care settings.

SMARTPHONE APPS

Some clinical AI tools are referred to by developers as "edge AI" — AI algorithms that are using data (sensor data or signals) created on the device. An example is an EKG app that runs on a smartphone so that patients can transmit a reading to a cardiologist who then can diagnose whether the patient had a heart attack. The AI converts the app data into an accurate EKG reading based on learning algorithms.



SMART CHATBOTS

This intelligent software can direct patients to the appropriate care setting — rest at home and take your medicine, make a doctor's appointment, go to urgent care or the ED, or call 911 — without human intervention 24/7.

Using AI to TREAT Patients Most Effectively

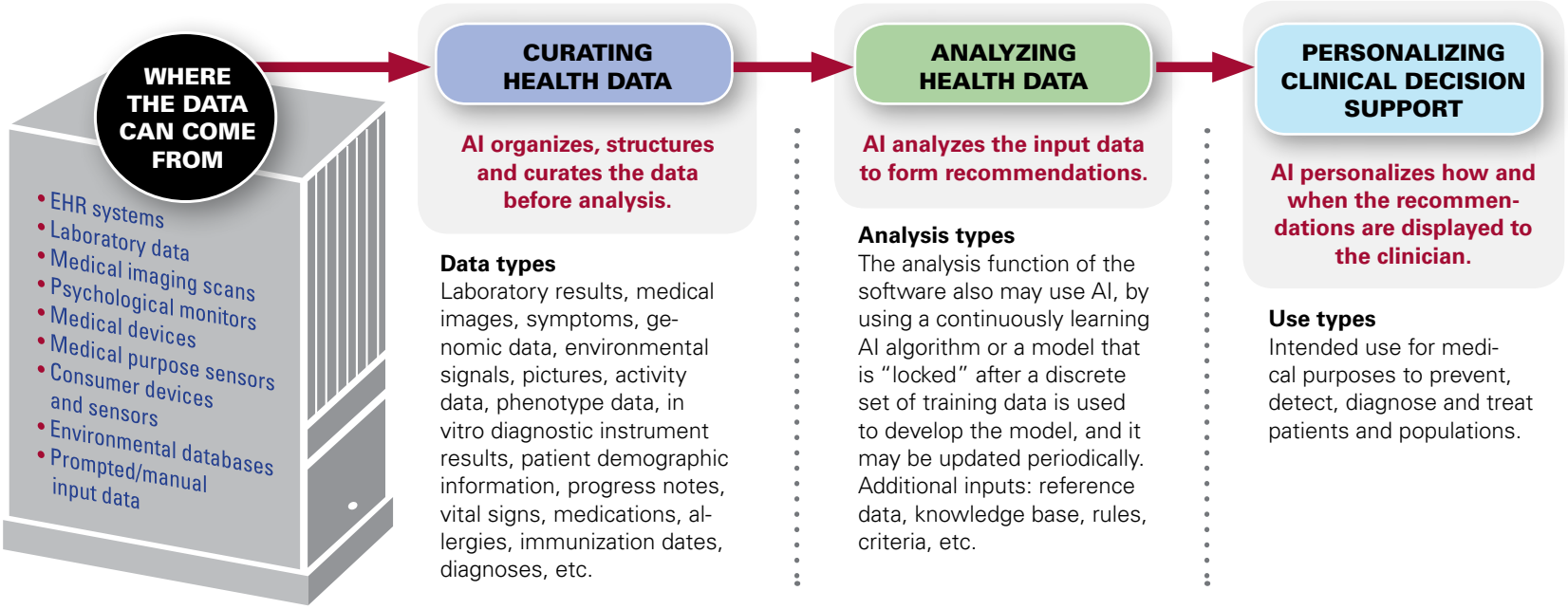
Evidence-based medical protocols and established clinical pathways work for most patients because researchers base them on what works for most patients. But, what works for most patients may not work for an individual patient.

AI can help clinicians identify the best treatment option for an individual patient. With medical knowledge regarding new treatments, medications, clinical trial results, real-world evidence, new medical technologies and devices, interventions and other innovative therapies growing exponentially, AI can electronically comb through the latest medical protocols, pathways and literature and marry that information to an individual patient's medical history, diagnosis, genetic makeup, environmental factors and social determinants of health. It brings precision to precision medicine. Some examples include:

- **Comorbid conditions:** A treatment may work on a patient with a single medical diagnosis, but not on the same person with that diagnosis along with several others.

Value of AI-enabled software for clinical decision support

This diagram, adapted from a Duke-Margolis Center for Health Policy white paper, summarizes the benefit of using AI in the process of developing a patient's treatment plan.



Source: Adapted from Duke-Margolis Center for Health Policy white paper "Current State and Near-Term Priorities for AI-Enabled Diagnostic Support Software in Health Care"

- **Personalize and target treatment:** Identify which characteristics indicate that a patient will have a particular response to a particular treatment by cross-referencing similar patients and comparing their treatments and outcomes. The resulting outcome predictions make it much easier for physicians to design the right treatment plan.

  Some medications work on all patients. Other drugs can't be metabolized by a subset of patients depending on their DNA.

  For example, in cancer treatment, AI can predict cancer cell sensitivity to therapeutics using a combination of genomic and chemical properties. AI coupled with patient data and national treatment guidelines can be used to guide cancer management.

- **Patient demographics:** The effectiveness of some treatments can vary by such patient demographics as gender, age and ethnicity.

Not only does AI-enabled software have the potential to individualize recommendations for the patient, but AI also can customize and provide the most useful information for a specific health care provider at a specific time. This ability could enhance integration of the software into the provider's workflow in much the same way as a smartphone uses AI to personalize the predictive text suggestions over time by learning which language the user regularly selects and which words are less relevant.

By providing clinicians with AI-enabled, software-tailored treatment options for individual patients at the point of diagnosis and care, treatment delays that can worsen a patient's medical condition may be avoided. Further, AI may make care safer for patients by not subjecting them to therapies that have little or no chance of working or may be harmful.

AI-powered technologies may also be used to drive patient compliance with treatment plans and drug therapies. AI can help clinicians identify patients at risk of noncompliance based on a number of factors. Then, clinicians and other caregivers can tailor interventions from the simple, like arranging transportation to a follow-up appointment, to the digital, like sending secure text messages reminding patients to take their medication. Data on the success or failure of those interventions as well as the success or failure of the treatment options subsequently is fed back into the AI algorithm to make it even more prescient.

DATA

49%

of patients say AI can help clinicians provide higher-quality health care

Source:ZS Associates, 2019

INSIGHT

The clinical leadership at a hospital or health system must be able to clearly articulate to other clinicians on staff how the AI technology will improve outcomes for patients.

Physician, Patient and Data Concerns About the Use of AI

Use AI to overcome an administrative challenge like patient scheduling? Sure thing. Use AI to automate a financial function like revenue cycle? Yes, of course. Use AI to make an operational task like inventory management more efficient? Absolutely. Use AI to diagnose and treat a disease? Let me think about it.

Far and away, the biggest challenges that hospitals and health systems will face when attempting to use AI in care delivery are concerns by physicians and patients.

Many physicians are concerned about the usability of the software and its effectiveness in delivering the right information in a way that is useful and trustworthy. Many patients are concerned about the privacy and safety issues of having AI diagnose and treat their injuries and illnesses. People tend not to trust machines and would prefer face-to-face consultations with their doctors. In fact, research and surveys consistently have shown those concerns and fears regarding AI in medicine.

Meanwhile, researchers from Boston University and New York University found consistent resistance by patients to AI as a caregiver under nine different scenarios. Their study, which appeared in the Journal of Consumer Research (2019), found that patients chose human providers over AI even when AI performed as well or better than humans and, in some cases, were offered financial incentives to use AI.

So, how can hospitals and health systems overcome these two barriers to the adoption of AI technologies that have so much promise to improve care delivery?

FOR PATIENTS, according to research and insights from the expert panel, it means doing three things:

1 | **Engage:** Use AI to engage with patients on a regular basis. Patients are accustomed to using AI-enabled technologies in other aspects of their lives, such as shopping online or making dinner reservations. The

more they experience technology in health care as a way to connect and stay healthy, the more comfortable they will be using it.

2 | **Connect:** Use AI and health chatbots to connect patients with clinicians. Patients will accept AI in care delivery if they know that human doctors and other clinicians back up AI, use AI as a tool and make the ultimate decisions about their care.

3 | **Personalize:** Use AI to personalize and individualize the health care experience. Patients will accept AI in care delivery if they believe AI can be fine-tuned and flexible enough to recognize their unique medical needs rather than treating all patients the same.

FOR PHYSICIANS and other clinicians, according to research and insights from the expert panel, overcoming barriers to AI technologies means doing the following:

1 | **Augmentation:** Leverage AI to augment clinical decision-making at the point of care. The AI solution must promise a better outcome and experience for the patient.

2 | **Workloads:** Use AI to manage increasingly unsustainable workloads. The AI solution must fit seamlessly into the clinician's care delivery workflow.

3 | **Verification:** Share clinical and scientific verification and valuation to confirm that the AI algorithm has been tested on a valid data set. How the AI solution works must be easily explainable to the physician.

4 | **Review:** Involve clinicians in reviewing processes, methodology, curation, integration and ethical decisions of AI systems and tools. Clinicians must be involved in the development and design of the AI solution from start to finish.

5 | **Learn:** Use validated frameworks and learn from successes and failures. The data must show that the AI technology solves the clinical problem it was designed for in real-world clinical settings.

Data Quality

The quality of data that AI learns from is also important and a potential barrier. The scale of data required for deep learning and diversity of different techniques makes it difficult to get a clear picture of how accurate AI systems might be in clinical practice or how reproducible they are in different clinical contexts (see sidebar).

DATA

Only 18%

of physicians support using AI to diagnose patients' medical conditions

Source:ZS Associates, 2019

PRO TIP

Like any technology, AI works best when you combine it with human intelligence. You're not going to replace doctors and nurses with AI. You're going to help doctors and nurses do their jobs with AI.

ETHICAL CONSIDERATIONS

Four tips to ensure that AI is safe for patients and care teams and to advance its use responsibly.

1 **In the context of bias in AI, a model needs to reflect socially responsible values.** The data used to teach AI are biased based on what research is conducted. The AI model should not discriminate against people based on age, gender, sexual orientation, race or ethnicity. Developers of AI tools and health care teams need to identify and take steps to address bias and avoid introducing or exacerbating health care disparities when testing or deploying new AI tools on vulnerable populations.

2 **Patient privacy is a key concern and affects how AI is developed and tested.** Privacy reflects on the nature of a provider's relationship with his or her patients; individual privacy must be protected at all times.

3 **Transparency in the AI algorithm is necessary to understand what went into it and why.** Can the model be explained? Physicians will seek insights into what AI is doing and won't accept a black box when it comes to patient safety, quality and outcomes.

4 **AI will only produce results as good as the data available to it.** With a vast amount of data coming in from multiple disparate systems, it is critical that organizations have an effective data governance strategy in place to maximize the full potential of their information assets – and the potential of AI.

4 Building Blocks of an Effective Clinical AI Program

PRO TIP

You should pick the clinical use cases that are most data intensive. Without the data, there's nothing to analyze to make predictions or come up with actionable insights.

DATA

33%

of tasks performed by health care "practitioners and technical occupations" can be automated.

Source:Brookings Institute, January, 2019

AI-powered clinical support tools may "think" for themselves, but they don't run by themselves. They need an effective infrastructure of people, policies, resources and technology. Members of the expert panel identified the attributes needed under each of these four foundational pillars:

1 **People:** Hospitals and health systems will need to set up an organizational chart and assign responsibilities to a group of leaders who not only will oversee the priority and execution of AI projects, but also will be accountable for their outcomes. In addition, organizations that turn to AI to improve care delivery across the continuum will need to assemble a team of AI experts who collectively know how to use AI technology to get actionable information in the hands of caregivers at the point of service. The team may include titles like chief AI officer, data scientist, AI engineer, data governance expert, data entry expert and data engineer. This expertise may be available through contracted services from health systems, academic medical centers or vendor partners. The team also will need a clinical champion who can clearly articulate the patient tasks to be done and keep the group focused on achieving the desired result. See the AHA Center for Health Innovation Market Insights report AI and the Health Care Workforce for more information on new competencies and critical success factors in integrating AI into the workforce.

2 **Policies:** Hospitals and health systems that turn to AI to improve care delivery across the continuum will need strong data governance. Because AI runs on data from internal clinical systems and other information systems, external data sources and platforms and, potentially, from other legal entities, hospitals and health systems need strong data governance policies to protect the privacy and security of patient data as it flows in and out of an AI algorithm.

3 **Resources:** Hospitals and health systems that turn to AI to improve care delivery across the continuum will need to invest in the resources needed to tap into the power of AI to achieve better outcomes and lower costs. That also means supporting the AI team with a realistic operating budget to ensure that AI produces the outputs expected by senior leaders. Health care leaders and clinical staff need dedicated time for training, planning, testing, implementation, evaluation and re-engineering of processes as needed to achieve desired outcomes.

4 **Technology:** Hospitals and health systems that turn to AI to improve care delivery across the continuum will need to invest in technology to achieve their clinical AI objectives. This technology investment falls into two broad categories. First is the AI technology itself, which must include all the hardware and software to run and to connect to all internal and external sources of data that feed AI. Companion technologies will need to convert the abundant, unstructured clinical data in care settings into structured data as AI can only feast on and learn from structured data. Second, providers will need to invest in technologies that not only integrate actionable AI insights into workflow on the front end but also technologies that feed data into AI algorithms to generate insights.

The successful deployment of AI technologies to improve care delivery requires hospitals and health systems to excel at these four pillars to build an effective clinical AI platform.

Conclusion

AI-powered technologies present opportunities for forward-looking hospitals and health systems to reimagine care delivery along every step of the care continuum. With the right infrastructure, partnerships with vendors, and clinician and patient buy-in, it can help prevent disease, detect important changes in patients' medical conditions, diagnose patients more accurately and faster, and tailor treatment plans to individual patients. The result is more value delivered to patients and communities.

Expert Panel

The AHA Center for Health Innovation thanks the AHA Committee on Clinical Leadership and the following people, organizations and sources for the time and insights that contributed to this Market Insights report.

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