AI and the Health Care Workforce

How hospitals and health systems can use artificial intelligence to build the health care workforce of the future

American Hospital Association™
Advancing Health in America

AHA CENTER FOR HEALTH INNOVATION | MARKET INSIGHTS

Executive Summary

Building a Smarter Health Care Workforce Using AI

Artificial intelligence (AI) has the power to transform how work is done in hospitals and health systems around the country, regardless of size or location. • AI is technology that mimics the human thought process, and machine learning (ML) is a type of AI that learns and improves as it processes more data. In health care, AI already may be deployed in back-office functions, scheduling and decision support, or close to deployment in imaging applications. AI can support critical decisions in the clinical setting by augmenting the knowledge of the care team to yield quicker diagnoses and identify the best treatment strategy for better outcomes. • As hospital and health system leaders consider ways to integrate AI, they should know that AI will:

- **Change the nature of how staff work at a hospital or health system.**
- **Change the skills or competencies needed by people working at a hospital or health system.**
- **Require new AI positions and technical talents that hospitals and health systems will need to attract.**
- **Require leaders to prioritize AI projects, and which to fund first.**
- **Require leaders to know enough about AI to work effectively with the larger ecosystem, including AI vendors.**
- **Demand that leaders effectively manage change to create a culture that embraces innovation and technology.**
- **Face significant subjective and objective barriers to adoption that can be overcome with skillful management and planning.**

This Market Insights report from the American Hospital Association's Center for Health Innovation guides senior hospital and health system leaders through key considerations for integrating AI into the workforce. It can be done, and it is being done with demonstrated improved outcomes while supporting clinical and quality goals. The AHA Center for Health Innovation thanks everyone for their contributions to this analysis.

Reshaping the Workforce with AI Technologies

When a patient visits a hospital five years from now, the exterior of the building may look the same. The interior of the hospital may look the same. Most of the people working there may even be the same. But how the work gets done inside and outside of the hospital will be markedly different, thanks to the boom in artificial intelligence technologies that are increasingly becoming available and affordable to forward-looking hospitals and health systems across the country, both large and small.

This Market Insights report from the American Hospital Association's Center for Health Innovation provides useful frameworks and tools for hospital and health system leaders to successfully integrate AI technologies into their workforce and workflows. Companion Market Insights reports will summarize the landscape of potential health care AI use cases and detail how hospitals and health systems can integrate AI into care delivery to make clinicians' work more effective and improve clinical outcomes.

How AI Will Change the Nature of Work

Artificial intelligence and its first and second cousins, machine learning and robotic process automation, respectively, will fundamentally change how most everyone working in hospitals and health systems will do their jobs in the future.

For the sake of brevity, this report refers to three technologies: artificial intelligence, machine learning and robotic process automation collectively as AI; however, there are critical differences across the three technologies and their potential workforce impacts that hospital and health system leaders need to know.

DATA

40%

of the tasks performed by health care "support occupations" can be automated, as can 33% of the tasks performed by health care "practitioners and technical occupations."

Source: Brookings Institute

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.

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 non-routine tasks or automate those tasks entirely.

RPA Will Impact Most Jobs

RPA provides hospitals and health systems with the ability to add capacity, decrease staffing costs and reduce human error by automating manual, repetitive, rules-based processes and enables health care workers to devote more time to assisting and caring for patients or higher-value functions that require human perception and judgment. Some examples of processes that are being automated with ML and AI tools include: billing, claims submission, patient enrollment, insurance verification, patient scheduling, inventory management and contract management. With cognitive technologies like speech recognition and natural language processing (NLP),

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 their administrative, financial and clinical workflows to drive more value for their organizations, their staffs 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.*

higher-order tasks also can be performed for intelligent automation.

The shift to RPA requires expertise not often found within the organization; consulting an expert might make sense for developing a strategy, selecting a vendor, and deploying and maintaining the RPA solution. The introduction of technologies may eliminate the need for employees with special skills previously required to do certain types of work, and leaders need to create a vision and road map for the future with new opportunities for displaced workers.

AI and ML Augment Decision-making

Automating tasks is one of the benefits of AI. Another more important benefit is the ability for AI and ML applications to help clinicians incorporate voluminous amounts of data and information into clinical decisions. Clinicians already benefit from ML models in such predictive tasks as detecting diabetic retinopathy or classifying skin cancer based on images of lesions. In the future, AI will make sense of the overwhelming amount of data created from genomics, biosensors, smartphone apps, the electronic health record (EHR), unstructured notes and data on social determinants of health, and create a broader context for clinicians to deliver high-quality, patient-centered care.

For AI to succeed in the clinical arena, data must be clean, accurate, up to date and trustworthy, and AI models must be tested for validity with the health system's patient population. Expect significant staff training and on-going support, engaging staff to use the tools correctly and optimizing workflows. Clinical and technical champions play a key role in getting buy-in, explaining changes in workflow and troubleshooting problems. In evaluating vendors, look for transparency in how analytics processes work. Clinicians will be skeptical about any "black box" tools that interact with patients.

Availability of Usable Data

Much of health care's data is unstructured, meaning it's not in a standardized and digitized format that a computer software program can easily digest and organize. That's why AI vendors are developing optical reader, voice recognition and NLP tools customized for health care. The challenge for hospitals and health systems will be how to extract data from internal and external information systems and build connections into their AI systems to send them enough structured data to have predictive value and produce useful outcomes.

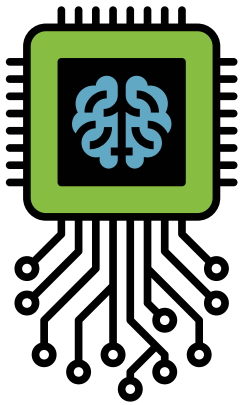
A related challenge will be how to protect the privacy and security of patient information as it flows in from myriad sources and is repurposed as fuel for AI models. There is concern that biases and deficiencies in the data used by

INSIGHTS

Hospitals and health systems need to leverage AI to free their clinicians from complex administrative tasks so they can spend more time on direct patient care.

PRO TIP

If you want AI to change how someone does his or her job, gradually work AI into the workflow. Don't try to do it all at once. You'll get a lot of pushback.



7 Ways AI Will Reshape the Health Care Workforce

Assuming the researchers are correct, AI could do 40% of the tasks done by nonclinical staff and 33% of the tasks done by clinical staff. What does that mean and how will that change the nature of work inside a hospital or health system? There are many possibilities, including:

1. **Improve productivity.** The same workers will be able to do more in less time as AI automates routine tasks.
2. **Improve efficiency.** The same workers will be able to do what they do better with fewer resources and at a lower cost as AI automates and improves routine tasks.
3. **Expand job responsibilities.** The same workers will be able to take on new or expanded duties as AI frees up their time for higher-level tasks.
4. **Practice at the top of license.** The same workers, particularly clinicians, will spend less time on administrative tasks and more time applying their unique clinical skills to direct patient care.
5. **Improve performance.** The same workers will achieve better outcomes as AI helps them reduce or eliminate human error and incorporate much more information into decision-making and actions. However, bias in algorithms, emanating from unrepresentative data or the reliance on flawed information that reflects historical inequalities, can lead to decisions which can have a collective, disparate impact on certain groups of people.
6. **Upskill staff.** The same workers will learn new and valuable digital skills as they work in tandem with AI technologies to produce better outcomes.
7. **Retrain staff.** As AI automates a large portion of current jobs, workers will be retrained and shift to other types of work.

machine learning algorithms may skew data against vulnerable or underrepresented groups and contribute to socioeconomic disparities in health care. That's why data governance policies need to be strengthened and upgraded to reflect the new data realities created by AI technology in the workplace. Large, sophisticated hospitals, health systems and integrated delivery networks (IDNs) may be able to do this on their own. Others may need to work with an AI vendor that is pulling in structured data from multiple sources to supplement the smaller hospital, health system or IDN's own data set.

AI Adds Value

The purpose of AI is to simplify tasks to produce better outcomes rather than job elimination; hospitals and health systems may end up cutting some jobs, retraining staff, upskilling workers and creating new positions as machines take over certain tasks from people. In the future, when people go to work at a hospital or health system, they will hit the power buttons on their computers just as before. But AI may do many of the things that they did before and do those things behind the scenes 24/7. Then, people will take what AI did and spend the rest of their day driving better clinical, operational and financial results for their hospitals or health systems.

New Positions, Competencies and Skill Sets

Reaching the point at which people working for hospitals and health systems can leverage what AI does and produce better clinical, operational and financial results will require significant changes in the composition, competencies and skill sets of the health care workforce.

What New Roles Will AI Create in Health Care?

In theory or in science fiction movies, AI runs and thinks by itself. In reality and in hospitals and health systems, AI needs someone to design it, install it, implement it, run it and monitor it. Some of the new positions and responsibilities that will be required include:

PRO TIP

Partner with local colleges and universities to create pathways for data-capable students to go into health care.

DATA SCIENTIST
This person knows how AI works and can design AI models to perform tasks required at a hospital or health system.

AI ENGINEER
This person builds the AI models to perform the tasks required at a hospital or health system.

DATA GOVERNANCE EXPERT
This person makes sure the data are clean and accurate by setting the policies around how data are collected. They are also responsible for making sure that when staff do their jobs, they're doing them ethically, protecting the privacy and security of patients' personal health information and following the data governance policies of the hospital or health system.

DATA ENTRY EXPERT
This person curates, cleans, scrubs and structures data from a variety of internal and external sources into the system that feeds AI models with the data they need to perform the tasks required at a hospital or health system.

DATA ENGINEER
This person builds the system that fuels the AI models with the data they need to perform the tasks required at a hospital or health system.

CHIEF AI OFFICER
This person leads the effort to explore potential opportunities, develop a cogent AI strategy, and harness the necessary funding, professionals, technology and organizational resources to implement them. They must understand the clinical workflow — the front-line workforce and the culture that drives care delivery.

Large hospitals, health systems and IDNs may need lots of each type of these positions. Smaller hospitals, health systems and IDNs may need fewer or just one of each type of these positions. Small or rural hospitals can outsource these positions to the AI vendors with whom they work.

New Digital Skills for the AI-enabled Professional

With AI as their new co-worker, staff will need to acquire new skill sets and competencies to take advantage of AI capabilities, and the educational pipeline needs to equip those entering the health care workforce with new skills. The hospital and health system employee of the future must have:

- **Digital acumen** — the ability to work comfortably with AI in several areas, including entering and accessing data, using data in their workflows and incorporating data/insights into decision-making.

- **AI acumen** — a basic knowledge of how AI works and an understanding of why it's generating certain outcomes, conclusions or recommendations based on the data it's being fed.

- **Data appreciation** — a passion for protecting the privacy and security of patients' personal health information as it's used by AI in new and different ways and for consistently following the hospital or health system's data governance policies.

- **An open mind** — a willingness to see AI as a career opportunity rather a threat to job security, to collaboratively work with other disciplines like technologists, operations and clinicians to design effective AI models and to maintain an open spirit of inquiry that allows for the assessment of the effectiveness of AI tools with an eye toward maximizing their operational effectiveness.

- **Agility** — More than anything else, the attribute to bring to work every day will be agility. The pace of health care AI technological advancements is accelerating, and so will the adoption of those technologies by hospitals and health systems. They need a workforce that can roll with change, turn on a dime and embrace a new AI model that creates more value.

DATA

91%

of health care executives say hiring and training talent for AI is a top priority for their organizations.

Source: OptumIQ

Renewed Focus on People Skills and the Patient Relationship

As AI and machines ease the burden on health care workers by reducing administrative tasks and mining and processing medical information and patient records for faster and more accurate decisions, staff time opens up for tasks that only a human can do — problem solving, critical thinking and having conversations with patients. In health care delivery, genomics, digital medicine and AI will transform clinical decision-making with more accurate and faster diagnosis and guidance on treatments for precision and personalized medicine. This clinical decision support, coupled with data feeds from patients who monitor their health with apps, will create a data-rich environment for providers to focus more on prevention, health and well-being. As a result, the workforce of the future not only will need people with technical skills, but also soft skills like communication and empathy to take full advantage of what AI gives them to do their jobs. If done right, AI can put the care back into health care with a renewed focus on personal interactions with patients — listening, empathizing and educating.

How to Develop Digital Skills in Your Workforce

Recomendations for HOSPITALS AND HEALTH SYSTEMS

- Strengthen systems to disseminate lessons from early adoption and share examples of effective, evidence-based technological change programs.
- Use validated frameworks to implement technological solutions and ensure that staff are trained to use these.
- Support collaborations between the health system and the field aimed at improving the skills and talent of health care staff.
- Work with stakeholders across the organization to review the regulation and compliance requirements for new digital health care technologies, including the provision of guidance and training on cybersecurity, data privacy and data anonymization.

Recomendations for HEALTH CARE LEADERS

- Provide access to training resources and educational programs in digital health care technologies to assess and build digital readiness of health care staff.
- Develop resources to educate and train all health care professionals in health data provenance (the description of where a piece of data comes from and the processes and methodology by which it was produced), curation, integration and governance; the ethics of AI and autonomous systems/tools; critical appraisal; and interpretation of AI and robotics technologies.
- Bring humanity to the machine-patient interface and focus on the essential human skills that AI and computers cannot achieve, such as collaboration, leadership, reflection, compassion and empathy.
- Involve staff in the co-design of transformation projects, particularly in identifying how digital health care technologies can help to improve both patient experience and staff productivity.
- Promote effective knowledge management to enable staff to learn from experience (both successes and failures) and accelerate the adoption of proven innovations.

Source: Adapted from "Preparing the healthcare workforce to deliver the digital future," NHS, February 2019.

Where to Begin the AI Journey

Hospital and health system executives have seen other fields and disrupters transform their operations and how they use their workforce with AI, and they know that AI can help to produce better health outcomes at lower costs.

That's why it's critical for hospitals and health systems big and small to start in the right place with the right tasks and the right technology in order to achieve the right outcomes. What a hospital or health system does can be separated into four categories: administrative, financial, operational and clinical delivery. Start with highly repetitive, transactional tasks where there are opportunities to capture a great deal of efficiency. Clinical applications are harder to incorporate and will need more clinical and professional support.

To gain employee support and improve employee satisfaction, health system leaders need to ask: How can the health system support its workforce more effectively through technology?

DATA

43%

of health care executives ranked automating business processes such as administrative tasks or customer service as their first choice for investment in AI technology.

Source: OptumIQ

Health System Operations that Can Benefit from AI Support

Some of the tasks and functions that meet criteria for AI automation by category.

Administrative

- Admission procedures.
- Appointment scheduling.
- Customer service responses.
- Discharge instructions.
- Hiring and orientation protocols.
- Licensure verification.
- Patient check-in procedures.
- Prior authorizations.
- Quality measure reporting.

Financial

- Billing and collections.
- Claims management.
- Insurance eligibility verification.
- Revenue-cycle management.

Operational

- Facilities management.
- Inventory management.
- Materials management.
- Supply chain management.

Clinical Delivery

- Automated image interpretation.
- Call center responses and triaging.
- Genomic diagnostics.
- Interventional and rehabilitative robotics.
- Patient navigation services.
- Predictive and prescriptive analytics.
- Sensors and wearables for diagnostics and remote monitoring.
- Speech recognition and natural language processing.
- Telemedicine.

For more use case studies, read our companion piece, **Surveying the AI Health Care Landscape.**

4 Steps to Organize Workforce Efforts to Successfully Adopt AI

Experts interviewed for this report recommend that hospitals and health systems take the following steps to identify the starting point or task on their journey to AI adoption throughout their organizations. The consensus of the experts is to start with a task in the four categories (administrative, clinical delivery, financial and operational) that meets the criteria and has a clear outcome rather than trying to solve a complex medical challenge with a sophisticated AI algorithm right out of the gate. Starting small with simple problems and building from there will keep a hospital or health system's workforce involved in solving organizational problems with AI and showing that AI is actually working. This concrete approach paves the way for future success in high-value use cases.

STEP 1

Identify the Task Environment

Identify the tasks in each of those four categories that have the following characteristics:

- The tasks are manual.
- The tasks are repetitive.
- The tasks are transactional.
- The data sets are limited (vs. unlimited).
- The data is structured (vs. unstructured).
- The data source is rich (vs. scarce).
- Automation of the task through AI would materially change the job of the worker for the better.
- Automation of the task through AI would reduce costs by making it more efficient and generate more value by producing better outcomes.

STEP 2

Select Tasks for AI Applications

Select the task from the four categories that best meets the criteria in Step 1 and, if performed more efficiently, could significantly impact progress toward a strategic goal or address a pressing need of the hospital or health system.

STEP 3

Start with Clearly Documented Workflow

Choose the first task that AI will automate based on those criteria. Start with a clearly documented workflow and understanding of the work before you automate or use AI.

STEP 4

Form a Multidisciplinary AI Project Team

Assemble a multidisciplinary team (and hire the appropriate outside AI vendor) to design, build, install, implement and monitor an AI solution that will transform that task.

45%

of health care executives say more than 30% of their new hires over the next year will be in positions requiring engagement with or implementation of AI.

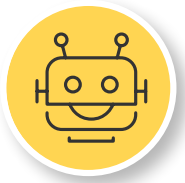
Source: OptimIQ.

INSIGHT

If a hospital or health system is not in a major metropolitan area, it's going to be challenging to hire and retain AI experts in a hospital setting. They may need to leverage a service.

INSIGHT

At every level of the organization, hospitals and health systems will need people who are digitally prepared and ready and who are capable of leveraging new technologies to do their jobs.



68%

of health care executives say that, by 2022, every employee in their organization will have access to a team of bots to help them do their work.

Source: Accenture

Overcoming Challenges to AI Adoption

When employees and clinicians hear AI, their minds typically jump to an image of a robot doing their jobs. In the development of AI for use in clinical delivery or administrative tasks, having clinician and staff input in how AI can best help them do their jobs can advance responsible use of AI. In the future, all jobs will require some level of digital skills, and staff will need training to work with AI technologies. Upskilling the workforce or teaching new skills as technology affords new opportunities is a priority as the technology may eliminate the need for special skills previously required to do certain types of work and displace workers. AI also will free up time and provide critical information and insights that can create categories of jobs that are much more proactive and effective in helping patients manage their health conditions — care/disease managers, expanded telehealth services, community health workers. Consequently, it's critical for hospitals and health systems to communicate the following messaging to employees and clinicians:

INSIGHT

Hospitals and health systems can't simply hire a data scientist and start creating value. That person has to be part of a collaborative, multidisciplinary team.

PRO TIP

Go after operational or administrative use cases first. They are the low-hanging fruit for AI.

PRO TIP

Talk to the vendor's other clients to whom it doesn't refer you to. They will tell you the real story.

6 Critical Success Factors in Integrating AI into the Workforce

It's not the technology, it's the people. Like any fundamental or disruptive change in how people do their jobs, those who use the technology daily will decide whether it succeeds, and AI in the health care workforce is no different. The expert panel identified six critical factors:

1 **Multidisciplinary team management:** Traditionally, new technology projects flow through the health information technology (IT) department. AI is different. It starts with the job to be done, and the technology is designed, built, installed, implemented and monitored around that task or function. As a result, AI projects require a dedicated multidisciplinary team approach to succeed. It takes administration, finance, clinicians, operations and technicians all working together as equals to solve a problem. It's not about the technology. It's about tech as an enabler.

2 **Change management:** The exact number of tenets varies by management guru, but adhering to some of the basics of change management will go a long way toward successfully integrating AI into the health care workforce. The basics include clearly articulating the purpose of the AI workforce integration and how the integration supports the organization's strategic goals; including the key people affected by the integration in the project; and effectively communicating the progress of the integration at each step.

3 **Culture:** Hospitals and health systems that have successfully integrated AI into their workforces have a culture that embraces innovation and technology, and that culture starts at the top of the organization with the CEO and other members of the executive team. The executive management also believes in the power of AI to improve the performance of everyone who works there. That culture will attract and energize AI champions in key administrative, clinical, financial and operational areas.

4 **Partnering with AI consultants and vendors:** A hospital or health system's choice of the right tasks to transform through AI also is the starting point for deciding whether to hire an AI consulting services firm to work with your health system on AI strategy — to identify challenges and opportunities and realistically assess the health system's data and analytics capabilities. As hospitals and health systems struggle with narrow AI use cases that need to be integrated into the workflow and existing systems, AI consultants can help integrate multiple vendor AI approaches to the myriad problems amenable to AI solutions and how systems can develop an overall approach to needed workforce/workflow changes with a variety of different vendors. See **Tips and Tricks for Selecting the Right AI Vendor Partner** to slice through the hype, know what questions to ask a potential vendor whether it's to assist with a homegrown AI project or run 100% of all AI projects outright.

5 **Workflow integration:** As with any other new technology, a new AI technology must fit into the users' existing workflows. If the purpose is to enhance the person's ability to do his or her job, then it has to be easy to use. Despite the benefits, the technology can't make the person's job more difficult by making users log into another system or adding additional tasks. If the integration isn't seamless, people won't use it nor will they generate the data that same AI technology uses to ensure high quality care.

6 **Project identification:** Successful integration of AI into the health care workforce requires planners to select tasks that have the greatest potential for AI to optimize with the least amount of time, money and resources. In addition to choosing projects with the greatest potential return on investment (ROI), also select projects that have the greatest potential to fundamentally change what someone does for the better. If hospitals and health systems hit on both — ROI and staff satisfaction — the odds of AI success are much higher.

Absent these six critical success factors, even the most powerful AI technologies will fail at a hospital or health system.

Conclusion

Forward-looking hospital and health system leaders see AI as perhaps the most effective path to a more productive, more efficient and higher-performing health care workforce. But realizing AI's full potential will require work on many fronts. It will take the collective effort of senior executives, health IT, operations, finance, clinicians, employees and new expertise to successfully integrate AI into the daily management of a hospital or health system. Five years from now, patients may not see anything or anyone new when they go to the hospital. But they will benefit from an entirely new experience driven by an AI-enabled workforce.

DATA

85%

of hospital and health system executives say members of their C-suite can embrace the rapid pace of technological advancements in health care.

Source: Korn Ferry

Expert Panel

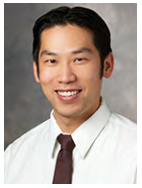
The AHA Center for Health Innovation thanks the AHA Committee on Clinical Leadership and the following people, organizations and sources for the time and insights that contributed to this Market Insights report.

Murielle Beene, DNP, MBA, MPH, MS, PMP, RN-BC, FAAN
Senior vice president and chief health informatics officer
Trinity Health
Livonia, Mich.

Jonathan Gleason, M.D.
Executive vice president and chief quality officer
Jefferson Health
Philadelphia

Thomas Kluz
Senior investment manager
Qualcomm Ventures
San Diego

Sean O'Brien
Senior director
Transformational solutions
Intalere
Pittsburgh



Jonathan H. Chen, M.D., PhD
Assistant Professor
Stanford Department of Medicine, Center for Biomedical Informatics Research + Division of Hospital Medicine
Stanford, Calif.

Steve Griffiths, Ph.D., MS
Senior vice president
Enterprise Analytics
Optum
Eden Prairie, Minn

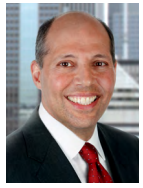
Peter Manoogian
Principal
ZS Associates
Boston

Roy Rosin
Chief innovation officer
Penn Medicine Center for Health Care Innovation
Philadelphia

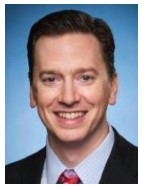
Benjamin K. Chu, M.D.
Managing director
Manatt Health
New York City

John D. Halamka, M.D., MS
International Healthcare Innovation Professor
Harvard Medical School
Executive Director
Beth Israel Lahey Health Technology Exploration Center, Boston

Richard Mackey
Senior vice president
Information technology
Intalere
Pittsburgh



Kaveh Safavi, M.D., J.D.
Senior managing director
Head of global health care practice
Accenture
New York City



Kevin Coloton
CEO
TrustHealthcare
Annapolis, Md.

M. Michelle Hood, FACHE
President and CEO
Northern Light Health
Brewer, Maine

Leslie Marsh, R.N., MSN, MBA
CEO
Lexington (Neb.) Regional Health Center

Rosemary R. Sheehan
Chief human resources officer
Partners HealthCare
Boston

Marty Fattig
CEO
Nemaha County Hospital
Auburn, Neb.

Pratap Khedkar
Managing principal
ZS Associates
Philadelphia

Karen Murphy, Ph.D., R.N.
Executive vice president and chief innovation officer
Founding director of the Steele Institute for Health Innovation
Geisinger
Danville, Pa.

Eric Topol, M.D.
Executive vice president
Scripps Research
Founder and director
Scripps Research Translational Institute
La Jolla, Calif.

Reports, Surveys, Articles and Research

- "100+ artificial intelligence companies to know in healthcare | 2019." Becker's Hospital Review. July 19, 2019. https://www.beckershospitalreview.com/lists/100-artificial-intelligence-companies-to-know-in-healthcare-2019.html
- Digital Health Tech Vision: Are you ready for what's next in healthcare? Accenture. June 4, 2019. https://www.accenture.com/_acnmedia/pdf-102/accenture-digital-health-tech-vision-2019.pdf
- "Looming Leadership Crisis in Healthcare: A survey of healthcare executives. Korn Ferry. Feb. 4, 2019. https://dsqapj1lakrkc.cloudfront.net/media/sidebar_downloads/kf-healthcare-succession.pdf
- "Preparing the healthcare workforce to deliver the digital future." NHS. February 2019. https://topol.hee.nhs.uk/wp-content/uploads/HEE-Topol-Review-2019-printable.pdf
- "OptumIQ™ Annual Survey on AI in Health Care." Optum. 2018. https://www.optum.com/resources/library/ai-survey.html
- "Trends for Scaling Innovation in Health Care." Center for Connected Medicine and the Health Management Academy. June 2019. https://www.connectedmed.com/documents/reports/ccm-research-trends.pdf
- Biro, Meghan M. "Recruiting AI Talent: 4 Ways To Get Ahead Of The Next Hiring Wave." Forbes. Jan. 24, 2019. https://www.forbes.com/sites/meghanbiro/2019/01/24/recruiting-ai-talent-4-ways-to-get-ahead-of-the-next-hiring-wave/#25e7734e59b0
- Bolland, Ian. "Robotic process automation: The way to bring about healthcare efficiencies?" Digital Health Age. Aug. 12, 2019. http://digitalhealthage.com/robotic-process-automation-the-way-to-bring-about-healthcare-efficiencies
- Chen, Jonathan H., M.D., and Asch, Steven M., M.D. "Machine Learning and Predictions in Medicine — Beyond the Peak of Inflated Expectations." New England Journal of Medicine 376, no. 26 (June 29, 2017): 2507-2509. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5953825
- Cohen, Glenn and Mello, Michelle. "Big Data, Big Tech, and Protecting Patient Privacy." Journal of the American Medical Association. Aug. 9, 2019. https://jamanetwork.com/journals/jama/fullarticle/2748399
- Darling, Paul and Khedkar, Pratap. "Beyond the Obstacles: Zeroing in on AI's Potential in Healthcare." ZS Associates. 2019. https://www.zs.com/publications/articles/zeroing-in-on-ais-potential-in-healthcare
- Fountaine, Tim et al. "Building the AI-Powered Organization." Harvard Business Review. July-August 2019. https://hbr.org/2019/07/building-the-ai-powered-organization
- Muro , Mark et al. "Automation and Artificial Intelligence: How machines are affecting people and places." Brookings Institution. Jan. 24, 2019. https://www.brookings.edu/research/automation-and-artificial-intelligence-how-machines-affect-people-and-places
- Ohlin, Olivia. "Half of hospital decision makers plan to invest in AI by 2021, study shows." Olive AI and Sage Growth Partners. Aug. 6, 2019. https://oliveai.com/hospital-decision-makers-plan-to-invest-in-ai
- Rebhan, Andrew. "What 125 health care leaders told us about their AI and analytics strategy." Advisory Board." Jan. 29, 2019. https://www.advisory.com/research/health-care-it-advisor/it-forefront/2019/01/ai-analytics
- Reinsel, David et al. Healthcare DATCON Level 3: An Industry with a Weak Data Management Pulse. IDC. November 2018. https://www.seagate.com/www-content/our-story/trends/files/idc-seagate-datcon-healthcare.pdf
- Reinsel, David et al. "The Digitization of the World — From Edge to Core." IDC. November 2018. https://www.seagate.com/files/www-content/our-story/trends/files/idc-seagate-data-age-whitepaper.pdf
- Taylor, Nick Paul. "Healthcare AI funding hits new high as sector matures." MedTech Dive. Aug. 7, 2019. https://www.medtechdive.com/news/healthcare-ai-funding-hits-new-high-as-sector-matures/560396
- Tran, Viet-Thi et al. "Patients' views of wearable devices and AI in healthcare" findings from the ComPaRe e-cohort." npj Digital Medicine. June 14, 2019. https://www.nature.com/articles/s41746-019-0132-y
- Zweig, Megan and Tran, Denise. "The AI/ML use cases investors are betting on in healthcare." Rock Health. March 12, 2018. https://rockhealth.com/reports/the-ai-ml-use-cases-investors-are-betting-on-in-healthcare
- Frey, Carl Benedikt and Osborne, Michael A. "The Future of Employment: How Susceptible are Jobs to Computerisation?" Working Paper. Oxford Martin School. University of Oxford, UK. Sept. 17, 2013. https://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf