

A Forrester Consulting  
Thought Leadership Paper  
Commissioned By IBM

February 2020

# The Cloud, Data, And AI Imperative For Healthcare

Hospital Readiness And Adoption Paths For  
Next-Generation Technologies

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# Executive Summary

The changing winds of cloud, data, and artificial intelligence (AI) have blown healthcare into uncharted territory. Growth of patient-centric engagement, value-based reimbursement models, and the need to alleviate pressure on staff have hospitals searching for a better way to manage their exponentially increasing data volume. Healthcare also remains a prime cybercrime target, with severe breaches galvanizing organizations to action. In response, healthcare delivery organizations are forging long-term strategic relationships with cloud vendors to secure patient data and unlock new clinical insights. Healthcare professionals must make strategic decisions on insights delivery, data migration, and interoperability as they race to the future of medical care.

In November 2019, IBM commissioned Forrester Consulting to evaluate healthcare needs, challenges, and opportunities across cloud and AI. Forrester conducted an online survey of 208 IT and business decision makers at large US healthcare organizations to explore this topic.

## KEY FINDINGS

- › **Healthcare has embraced hybrid cloud operating models.** Driven by increased IT demands and the need for improved security, hospitals have adopted a hybrid mix of public and private cloud services. Healthcare organizations use cloud-native vendors for an increasing number of client-facing apps, while back-office technologies less sensitive to latency issues are more often hosted on public clouds than on-premises.
- › **Healthcare organizations overestimate their effectiveness at data security.** While 85% of healthcare decision makers rated their organizations as effective at securing patient data, the frequency and severity of industry data breaches suggest overconfidence. Cybercriminals are conducting ransomware attacks that are increasing in sophistication and volume, risking patient safety and core hospital operations.
- › **Large health systems struggle with data management.** Data management is a limiting factor to deploying more advanced analytics and AI/machine learning (ML) capabilities. Both technical expertise and access to appropriate data rank as top challenges and barriers in AI implementation. Without appropriate data access — or clinically reliable, clean data — integrating insights into existing clinical workflows remains elusive.
- › **Cloud and AI technology usage benefits patients and providers.** More than one-third of existing cloud users have improved patient care, and three-quarters of AI users have improved both patient care and patient experience. Technology adoption is also correlated with Hospital Consumer Assessment of Healthcare, Providers, and Systems (HCAHPS) scores. Hospitals with higher HCAHPS scores are 1.6 times more likely to value availability of comprehensive, end-to-end solution-to-support hosting, analytics, AI, and application development/insight delivery as a critical vendor capability. High-scoring organizations are also twice as likely to be very effective at abstracting insights from data.

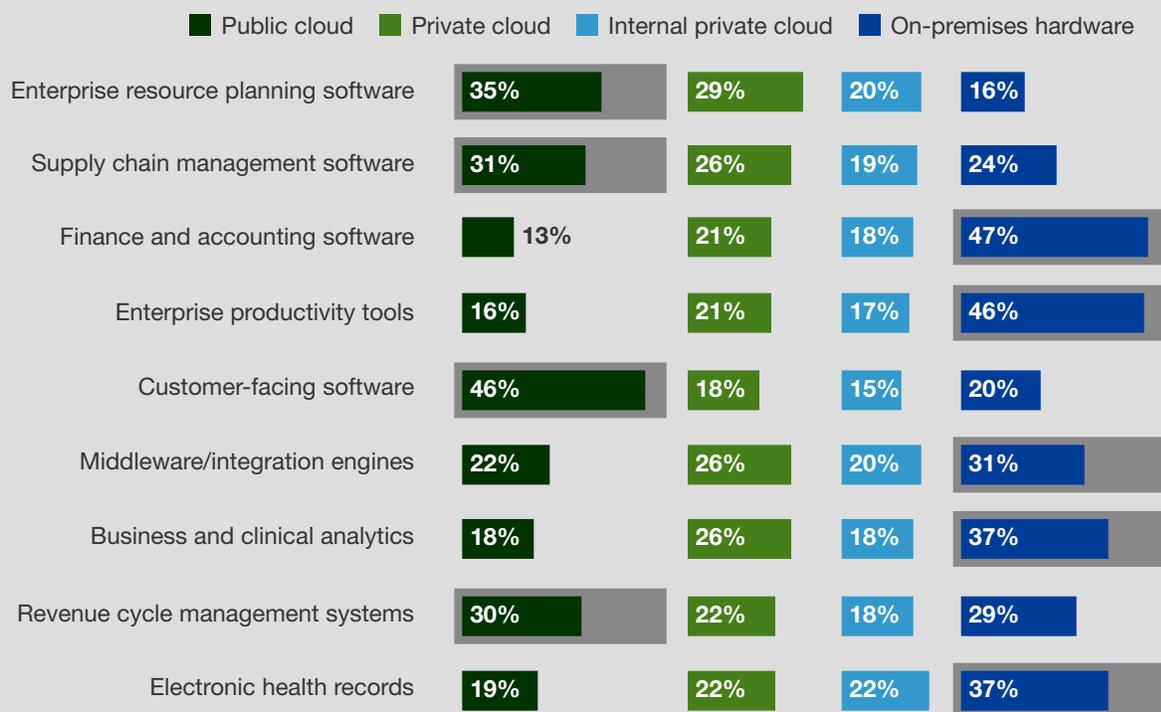
# The Cloud Migration Path Is Muddy, But The Summit View Is Worth The Trek

Healthcare organizations plan to migrate their workloads to the cloud in record numbers: 43% of healthcare infrastructure professionals have implemented public cloud, and another 18% are joining them within the next twelve months.<sup>1</sup> In surveying 208 healthcare respondents, we found that:

- › **Healthcare is firmly entrenched in the hybrid cloud operating model.** When it comes to where various workloads are run, hospitals are leveraging a hybrid mix of public and private cloud services (see Figure 1). Sensitive enterprise systems like electronic health records or finance and accounting software still largely remain on-premises, while organizations are using cloud-native vendors for an increasing number of client-facing apps. Back-office technologies that are less sensitive to latency issues — like enterprise resource planning (ERP), supply chain management (SCM) and requirements chain management (RCM) — are now more often hosted on public clouds than on-premises. While this hybrid approach suggests organizations are seeking the right tools for the specific jobs to be done, multicloud hosting may also introduce challenges in integrating data, tools, and security governance across cloud environments.<sup>2</sup>

Figure 1

“What percentage of your organization’s workloads run in the following environments?”



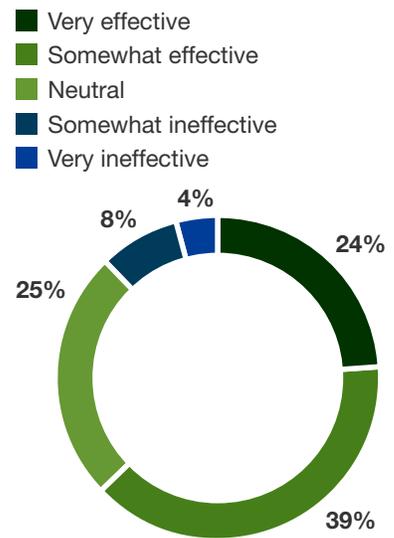
Base: 208 IT and business decision makers at large US healthcare organizations

Source: A commissioned study conducted by Forrester Consulting on behalf of IBM Healthcare, December 2019

- › **Scalability and the need for improved cybersecurity drive shifts to cloud.** Sixty-one percent of respondents indicated that increased IT infrastructure demands drove them to adopt cloud (see Figure 2). Improved cybersecurity and risk management follow closely behind. With years of devastating data breaches and revenue loss directly attributed to poor security, hospitals feel an urgent need to have offsite records backup to ensure continuous service in the face of increasingly frequent and sophisticated ransomware attacks.<sup>3</sup> They are looking to cloud vendors with security expertise to act as strategic advisors.
- › **Many organizations seek to increase innovation through their cloud providers.** With less than a quarter of organizations that are very effective at innovation (see Figure 3), healthcare decision makers are looking to partner with cloud providers on the next generation of technology that might help forecast surgical complications, surface gaps in care, and identify patient eligibility for chronic disease management programs. Forty-four percent adopted cloud to access new and innovative middleware services, while 41% sought access to innovative AI services (see Figure 2).

Figure 3

“How effective is your organization at pursuing innovation?”



Base: 208 IT and business decision makers at large US healthcare organizations  
 Source: A commissioned study conducted by Forrester Consulting on behalf of IBM Healthcare, December 2019

Figure 2

“What drove your organization to adopt cloud?”



Base: 202 IT and business decision makers at large US healthcare organizations  
 Source: A commissioned study conducted by Forrester Consulting on behalf of IBM Healthcare, December 2019



The No. 1 reason organizations adopt cloud is to address increased IT infrastructure demands.

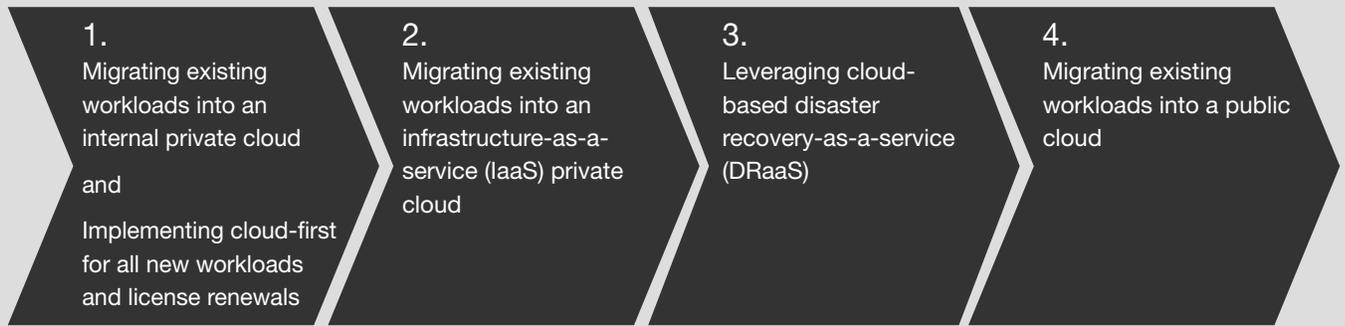
- › **Hospitals struggle to define migration strategy, leading to widely varied migration paths.** Forrester asked respondents what steps their organizations took to migrate; the most common response was to implement cloud-first for all new workloads and migrate existing workloads to an internal private cloud, followed by a hosted private cloud migration, leveraging disaster-recovery-as-a-service (DRaaS), and then public cloud migration (see Figure 4). However, responses varied widely; organizations took up to nine steps, and responses varied by seven percentage points or less. Well-defined migration planning is a must to reduce cost, complexity, and disruption to business operations, yet 83% of decision makers found defining migration strategy to be very or extremely challenging, underscoring the lack of known cloud migration best practices.
- › **Compliance is the biggest headache for upgrading technology.** Eighty-eight percent of respondents found regulatory compliance to be very or extremely challenging when migrating to a cloud environment (see Figure 5). Some vendors still take an industry-agnostic approach to cloud services delivery that leaves healthcare clients wanting more.<sup>4</sup> While cloud vendor compliance has drastically improved in recent months, healthcare systems' regulatory uncertainty remains because each vendor establishes its own framework of shared responsibilities, resulting in a patchwork of compliance mandates.
- › **Cloud technology benefits internal operations and patient care.** When asked what benefits organizations have been realized from cloud migration, respondents identified several operational benefits: improved IT infrastructure management (41%), improved disaster recovery (39%), and improved application performance (39%). More than a third of cloud users also have seen a positive impact on patient care (see Figure 5). Cloud usage is also correlated with higher HCAHPS scores: Hospitals with 4+ HCAHPS stars are 1.6 times more likely to leverage software-as-a-service (SaaS).



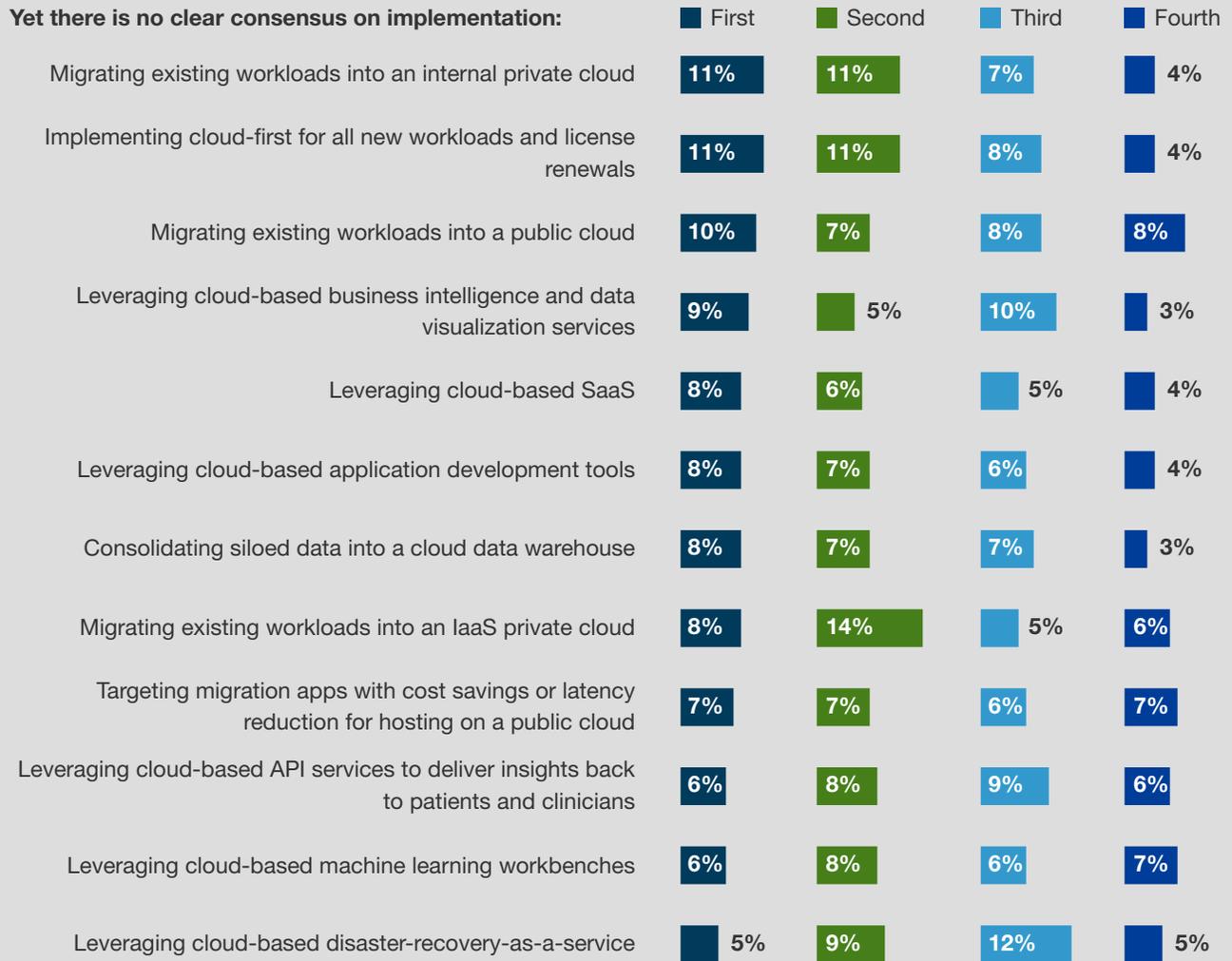
Firms with 4+ HCAHPS stars are 1.6 times more likely to leverage cloud-based SaaS.

**Figure 4: Cloud Migration Activities, By Order Of Implementation**

The most common path is:



Yet there is no clear consensus on implementation:



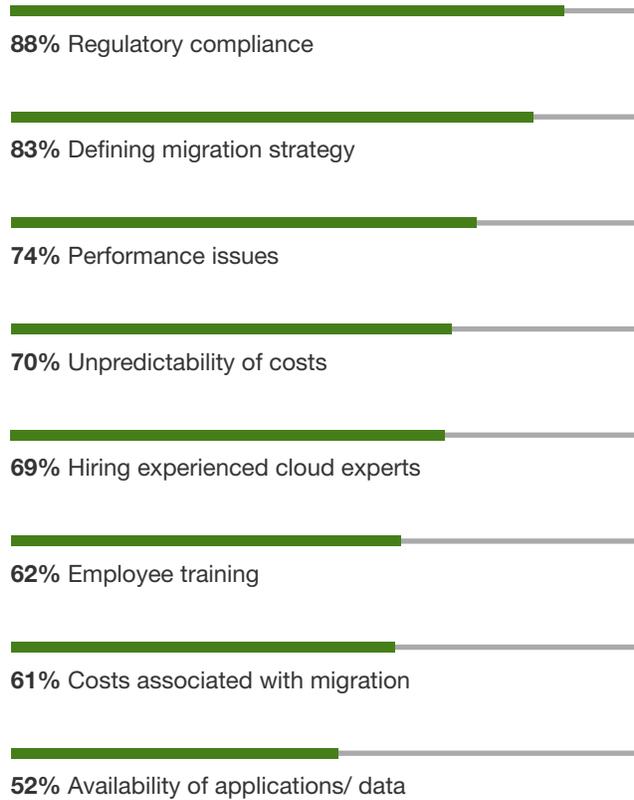
**83% found defining migration strategy to be very or extremely challenging**

Base: 192 IT and business decision makers at large US healthcare organizations

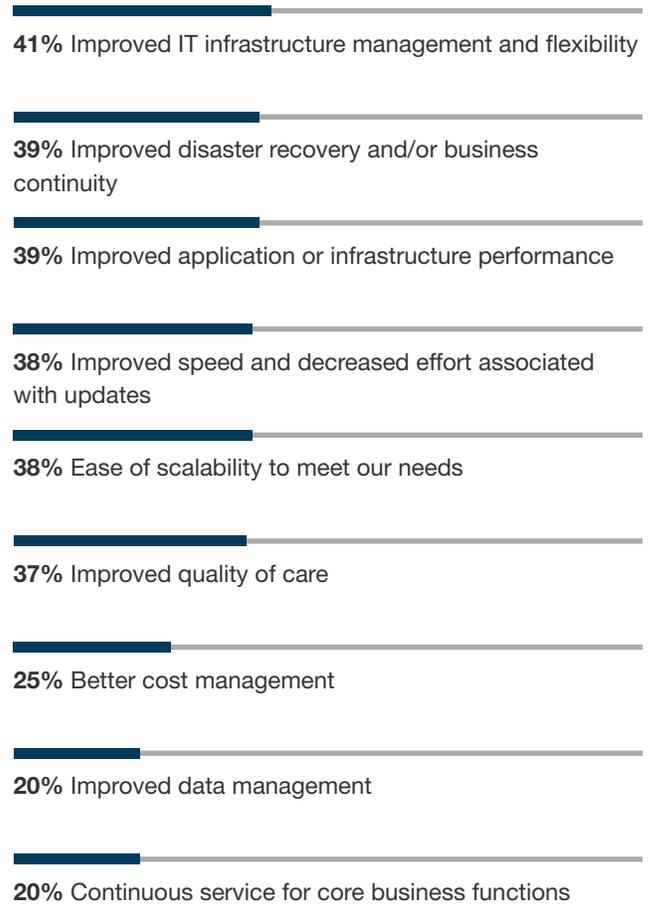
Source: A commissioned study conducted by Forrester Consulting on behalf of IBM Healthcare, December 2019

**Figure 5**

**“To what extent were the following challenges for your organization when migrating to a cloud environment?”**  
(Showing “Very”/“Extremely challenging”)



**“What are the most important benefits your organization has realized from migration to a cloud environment?”** (Showing sum of top three selections)



Base: 202 IT and business decision makers at large US healthcare organizations

Source: A commissioned study conducted by Forrester Consulting on behalf of IBM Healthcare, December 2019

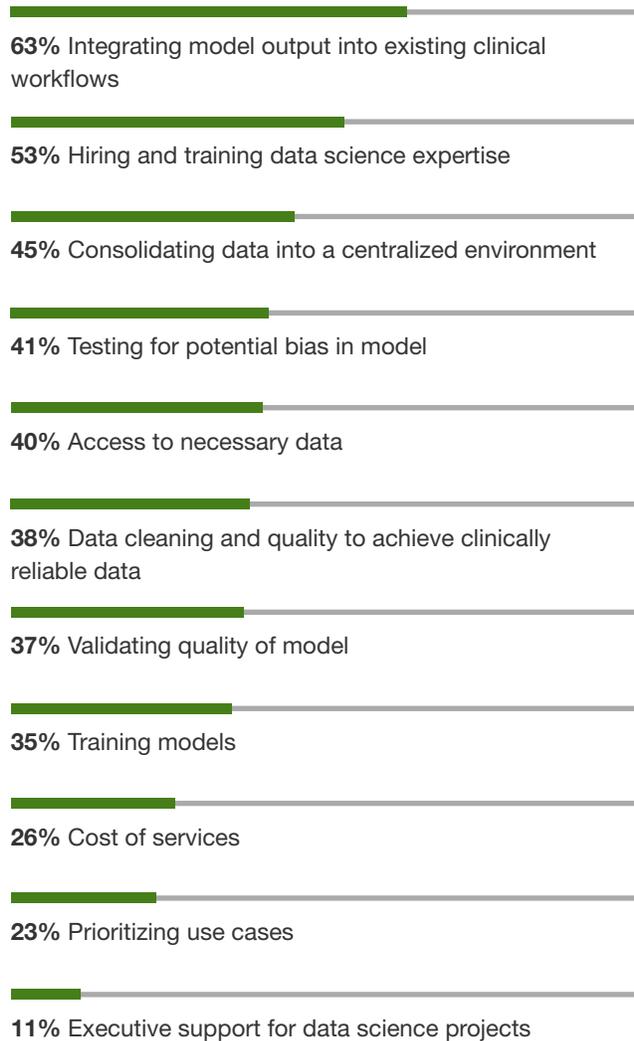
# To Leverage AI, Organizations Must Navigate Pothole-Riddled Data Terrain

Healthcare companies are struggling with the exponential increase in the volume and type of data that they must ingest, curate, analyze, govern, share, and archive — all while complying with data security and privacy regulations. To successfully manage and make sense of this data, organizations must overcome talent, infrastructure, and security challenges (see Figure 6). We found that:

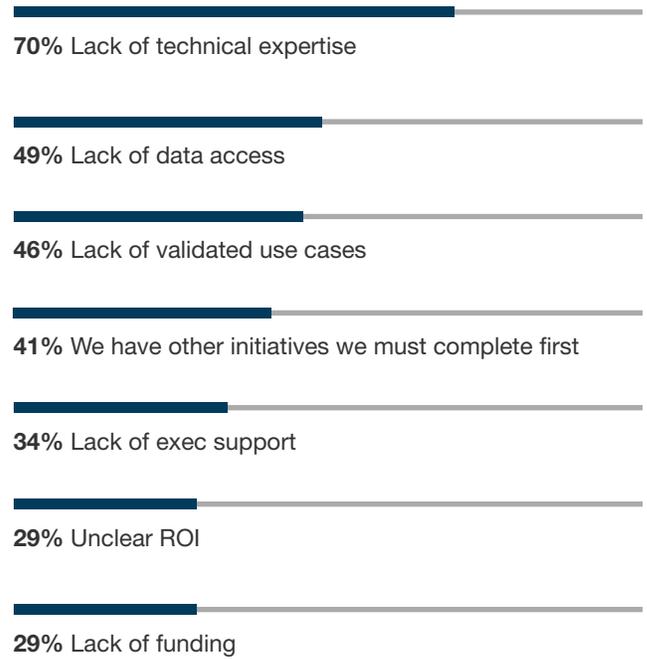
- › **While leadership supports AI, implementation is challenging.** Eighty-nine percent of respondents indicated that executive support for data science projects was not extremely challenging. However, other major elements of AI implementation stand out as headaches. Everything from integrating insights into existing clinical workflows (63%) to consolidating fragmented data (45%) to achieving clinically reliable, clean data (38%) was rated as extremely challenging. In an industry that continues to converge through mergers and acquisitions (M&A), lack of system interoperability is a likely culprit for data fragmentation and access.<sup>5</sup>
- › **Talent shortages block AI adoption.** At the heart of the implementation challenges is a major roadblock of hiring and training data science expertise. Sixty-three percent of respondents whose organizations implemented AI technology found this activity extremely challenging. For organizations that have not yet adopted AI, lack of technical expertise was also a top barrier, with seven out of 10 respondents ranking it in their top three reasons for not using AI. Major cloud vendors are addressing this gap by creating AI development tools that simplify the ML development process, building libraries of pretrained models, and offering a model marketplace that further extends availability of pretrained models.
- › **Healthcare organizations struggle with insight delivery.** Integrating insights into existing clinical workflows presents the biggest AI implementation challenge. However, some cloud vendors are finding novel ways of delivering AI predictions to clinicians, such as out-of-the-box support for Fast Healthcare Interoperability Resource (FHIR) APIs, leveraging a care management software system, building a side panel application to present the information, or using chatbot services with secure messaging platforms.<sup>6</sup>

**Figure 6**

**“To what extent were the following challenges for your organization when implementing AI?”**  
(Showing “Extremely challenging”)



**Reasons organizations have not yet implemented AI**  
(Showing sum of top three selections)\*



Base: 133 IT and business decision makers at large US healthcare organizations

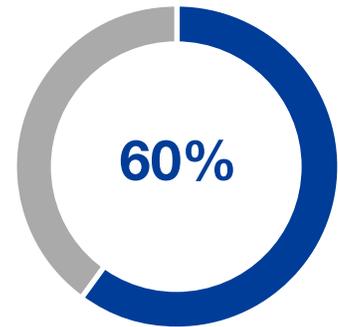
\*Base: 75 IT and business decision makers at large US healthcare organizations

Source: A commissioned study conducted by Forrester Consulting on behalf of IBM Healthcare, December 2019

› **Healthcare decision makers claim their organizations are effective at data security, but frequency of industry security events suggests otherwise.** Eighty-five percent of respondents rated their organizations as effective at securing patient data, making it the top capability across a number of technology and healthcare outcome capabilities that we surveyed (see Figure 7). However, years of embarrassing data breaches suggest otherwise; the US Office for Civil Rights (OCR) settled 10 HIPAA violation-related breaches in 2018 to the tune of \$28 million in fines. In one of the worst examples, a compromised network led to the loss of 79 million patient records.<sup>7</sup> As cybercriminals demonstrate an increasingly alarming degree of sophistication with ransomware attacks, these events are even more damning to the victims, as they put patient safety and core hospital operations at risk. Security and risk professionals increasingly trust public cloud providers to act as strategic partners and advise them on top cloud security decisions, as evidenced by 60% of respondents adopting cloud due to the need for increased cybersecurity (see Figure 8).

Figure 8

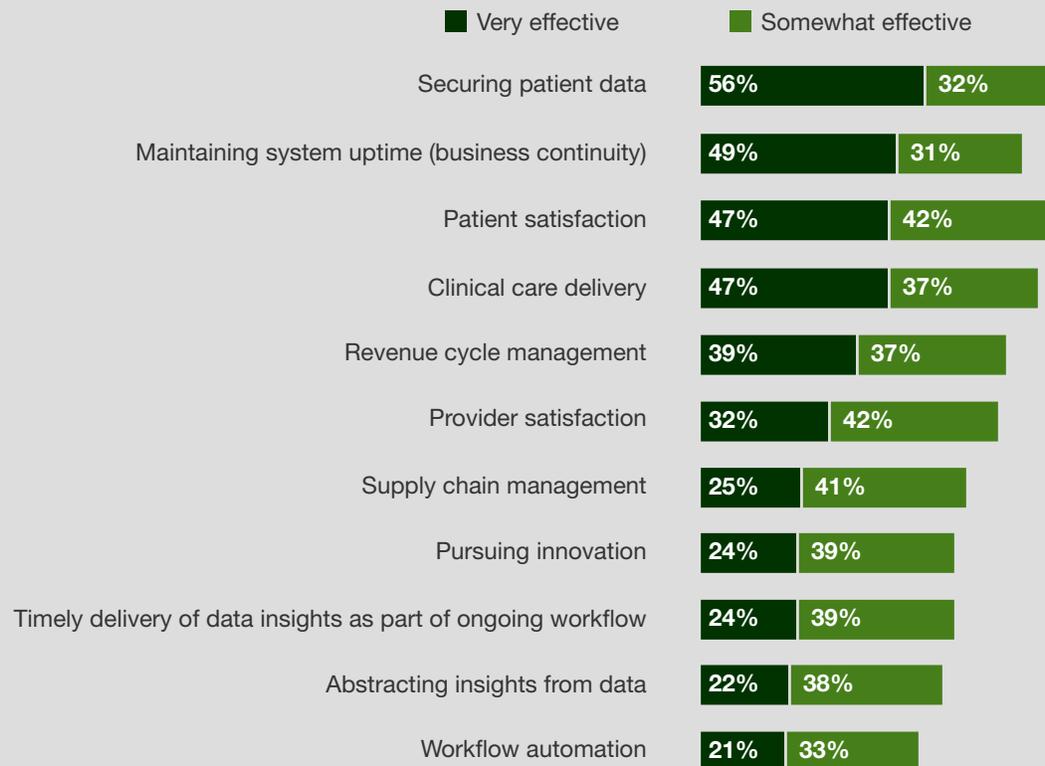
**My organization adopted cloud for improved cybersecurity/risk management**



Base: 202 IT and business decision makers at large US healthcare organizations  
 Source: a commissioned study conducted by Forrester Consulting on behalf of IBM Healthcare, December 2019

Figure 7

“How effective is your organization at each of the following?”



Base: 208 IT and business decision makers at large US healthcare organizations  
 Source: A commissioned study conducted by Forrester Consulting on behalf of IBM Healthcare, December 2019

# Despite Challenges, AI Provides A Clear Map To Better Patient Outcomes

With data maturity comes the opportunity for healthcare organizations to take advantage of AI and machine learning to directly increase revenue, improve patient outcomes, and enhance patient experience. In surveying healthcare professionals about their AI usage, we discovered that (see Figure 9):

- › **AI leads to improved patient outcomes and experience, as well as provider experience.** Almost three-quarters of healthcare organizations using AI tools have improved quality of care and enhanced patient experience. The impact to patient experience extends beyond delivering great care; it also creates a virtuous circle, as patient experience and satisfaction are factors of government payouts for hospitals, enabling them to serve an even greater population. Organizations have also seen results for their employees, with a majority seeing AI benefiting the work life of health care providers. Data capabilities are also correlated with higher HCAHPS scores: Organizations with four or more stars were twice as likely to be very effective at abstracting insights from data and 1.6 times more likely to value availability of comprehensive, end-to-end solution-to-support hosting, analytics, AI, and application development/insight delivery as a critical cloud vendor capability.
- › **Data insights platform adoption is mature while interest in deep learning/machine learning is growing.** Sixty percent of respondents' organizations have adopted a data insights platform, with another 19% intending to implement in the next 12 months. In parallel, organizations are exploring other digital decisioning and machine learning platforms, as well as deep learning frameworks; almost every respondent (96%) said their organization either has implemented, plans to implement, or is interested in exploring these capabilities.
- › **AI interest focuses on areas that impact the bottom line.** The AI use cases respondents selected as being the most critical often had a link to profit or revenue. Forecasting surgical complications (57%), identifying gaps in care (56%), and identifying patients eligible for enrollment in chronic disease management (53%) topped the list, suggesting that AI investments may have a positive ROI while enabling organizations to better serve various patient communities.



Firms with 4+ HCAHPS stars are 2 times as likely to be very effective at abstracting insights from data.

**Figure 9**

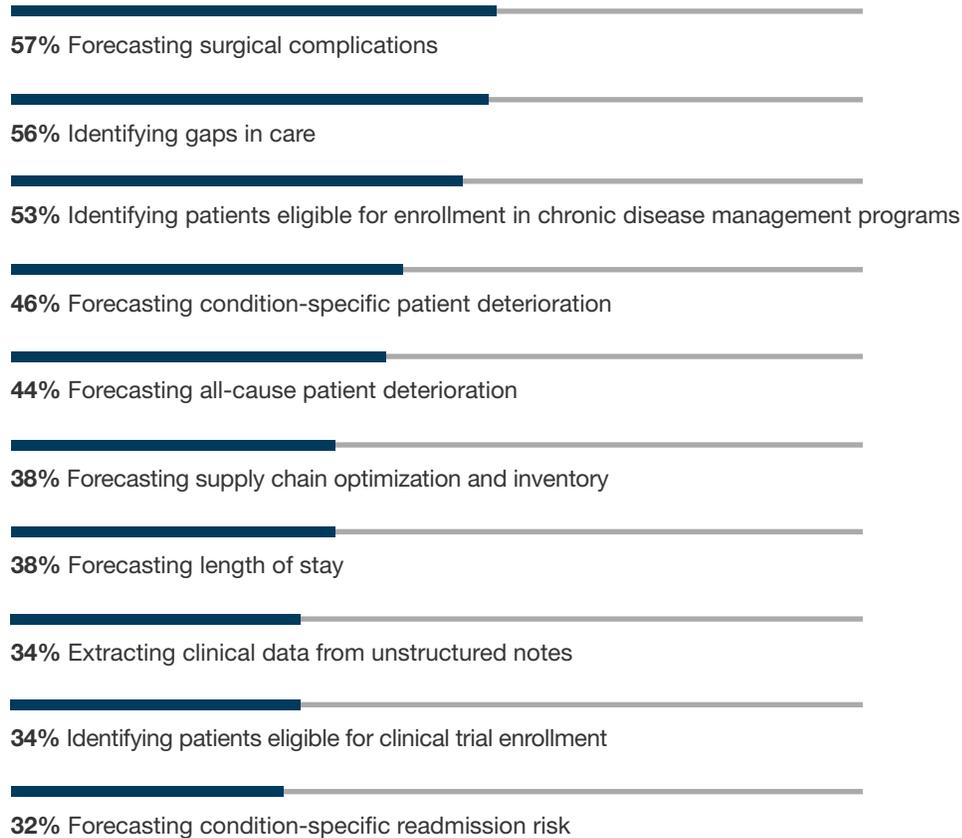
**“What benefits has your organization realized from use its AI tools?”**

(Showing sum of top three ranked)



**“To what extent are the following AI use cases important to delivering effective healthcare?”**

(Showing “Critical,” top 10 responses)\*



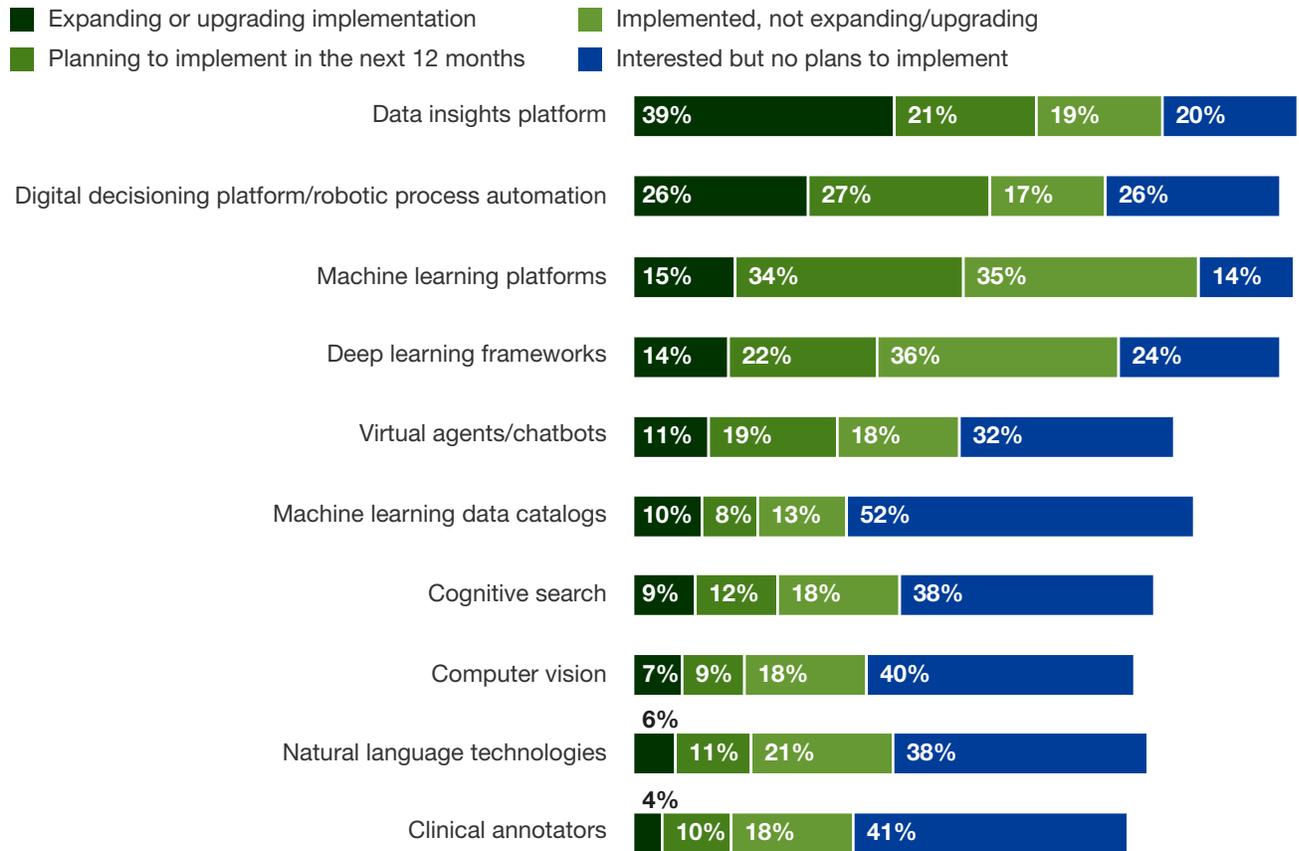
Base: 133 IT and business decision makers at large US healthcare organizations

\*Base: 208 IT and business decision makers at large US healthcare organizations

Source: A commissioned study conducted by Forrester Consulting on behalf of IBM Healthcare, December 2019

Figure 9 (Cont.)

“What are your organization’s plans when it comes to implementing the following AI tech?”\*



Base: 133 IT and business decision makers at large US healthcare organizations

\*Base: 208 IT and business decision makers at large US healthcare organizations

Source: A commissioned study conducted by Forrester Consulting on behalf of IBM Healthcare, December 2019

# Key Recommendations

Forrester's in-depth survey yielded several important recommendations. To effectively leverage cloud and AI to improve patient outcomes, patient experience, and operations, your healthcare organization should:



**Preserve patient privacy in the digital age.** Though 88% of healthcare decision makers reported being effective at securing patient medical records, evidence from the field suggests this data may be a case of overconfidence, as healthcare has been the subject of widespread data theft and ransomware attacks for years. Today, healthcare organizations report that they are moving to the cloud to thwart this potential risk. Improved cybersecurity and business continuity are among the highest reported benefits executives associate with cloud migration. As healthcare organizations race to aggregate patient data in the cloud, the potential for damage to brand reputation is high. Mitigate this risk by ensuring you only work with vendors that have HITRUST CSF certification and a strong track record of working with healthcare providers. Plan cloud migration strategies with a professional services firm that has strong cloud security expertise, ensure that data is being stored with a vendor that has high consumer trust, and — above all — ensure that patients can opt out.



**Chart your course toward digital transformation.** Health system executives reported that defining a migration strategy is a leading challenge in their cloud migration journeys. Evidence of the industry's uncertainty in this area can be seen in the sheer volume of different migration pathways surfaced through our migration pathway analysis. Early adopters took a dizzying number of routes through their cloud migration, but today major cloud vendors have cultivated certified partner marketplaces where clients can find professional services organizations that offer healthcare cloud migration planning and execution support for a range of price points. These vendors guide health systems toward a hybrid strategy that ensures latency, security, scalability, and cost predictability are engineered at the design stage.

Similarly, a key barrier to AI adoption is a lack of technical expertise. Major cloud vendors are now racing to close this usability gap, enhancing AI workbenches and data processing pipelines to ensure that these capabilities can be leveraged by nondata scientists and, increasingly, by noncomputer programmers. Cloud vendors are differentiating on the ease of use of AI services, the depth and breadth of healthcare-specific pretrained models, and the availability of a model marketplace where third-party pretrained algorithms can be acquired and implemented.

Major cloud vendors are acutely aware that buyers are reluctant to move forward with digital transformation partnerships due to lack of staff expertise. These vendors are bringing professional services, partnership ecosystems, and curated marketplaces to market to provide industry-specific solutions to this problem. As with any major technology implementation, healthcare leaders need to lean on trusted partners to close these knowledge gaps and move forward with their organizational digital transformation strategies.



**Build your cloud data insights platform.** The heart of digital transformation is the data insights platform, where electronic health record (EHR) data, medical imaging data, claims data, genomics data, patient-generated health data, and increasingly social data is aggregated, deduplicated, deidentified, and analyzed in a data-processing pipeline capable of churning out predictive algorithms that have the power to improve clinical outcomes and patient experience. When evaluating cloud vendors for digital transformation partnerships, spend ample time exploring the data insights platform features and functions, as well as the capabilities of the vendor and/or its partner ecosystem to support use case identification, model training and validation, and bias testing. Start with a focused use case. Demonstrating success from AI investments early will preserve and expand executive support. Peer organizations are pursuing use cases including predictive algorithms that forecast post-surgical complications and cognitive search algorithms that identify patients eligible for remote patient monitoring enrollment.

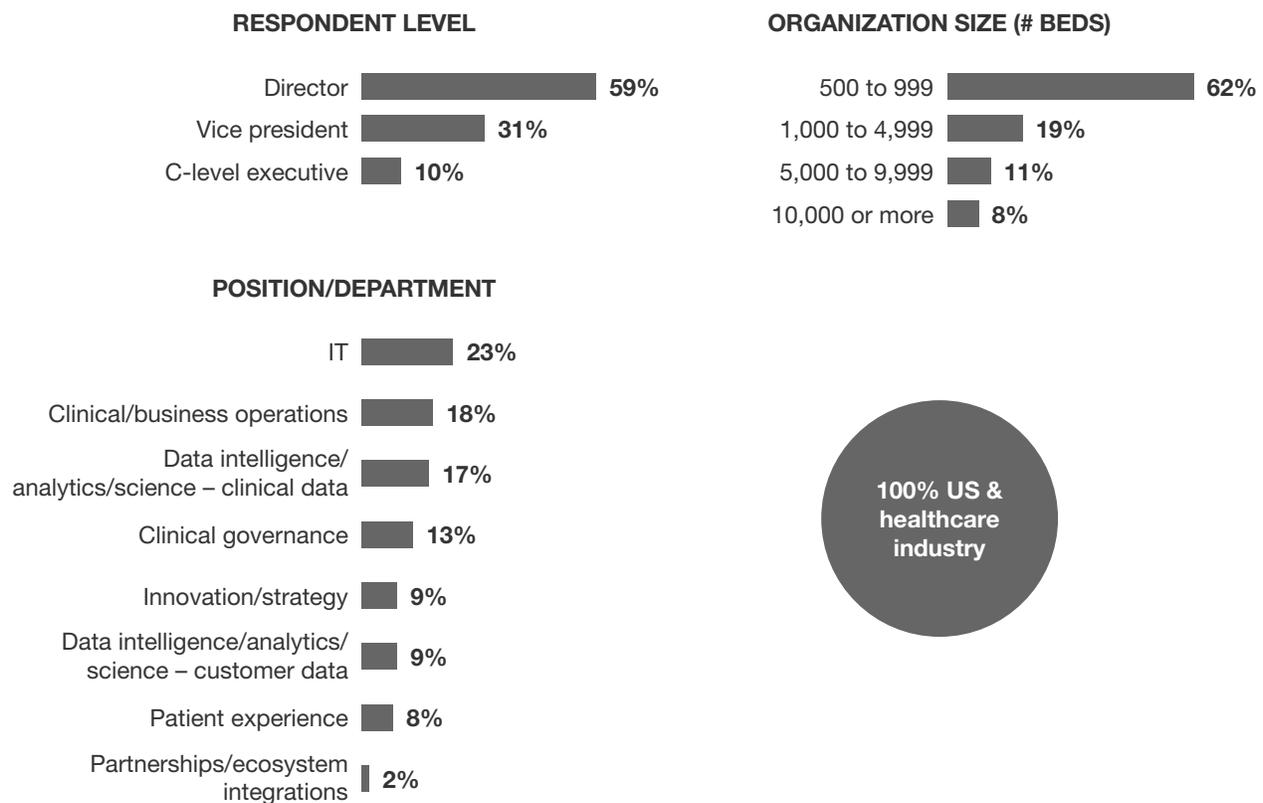


**Integrate insights back to the bedside.** Healthcare decision makers report that the most challenging AI implementation issue they face today is integrating insights back into the clinical workflow. To overcome this, healthcare process design leads need to first establish who is best suited to receive the information — a primary care physician (PCP), a care manager, or even a home health aid. Place of service and urgency of the alert will guide routing decisions. Delivery mechanisms abound, and health systems are innovating new channels to bring insights to clinicians. Cloud vendors are increasingly offering out-of-the-box support for FHIR APIs, but due to relatively closed off EHR security postures, data cannot be pushed into key workflow processes for most of these systems. As a result, many health systems leverage cloud application development environments to build a sidepanel application to contextually present patient information as providers navigate through their EHR workflows. Others are experimenting with chatbots as a delivery mechanism, and still more are turning to voice as a potential channel for delivering insights to the bedside. Cloud vendors offer a multitude of options to experiment with — work with local end users to establish an ideal insight delivery pathway as new models are implemented.

## Appendix A: Methodology

In this study, Forrester conducted an online survey of 208 IT and business decision makers at large US healthcare organizations to evaluate the challenges, needs, and opportunities as they make decisions relative to cloud and AI. Survey participants included decision makers in various positions such as patient experience and clinical governance. Questions provided to the participants examined the readiness of these organizations to take advantage of technology within cloud and AI. Respondents were offered a small incentive as a thank you for time spent on the survey. The study began in November 2019 and was completed in December 2019.

## Appendix B: Demographics



Base: 208 IT and business decision makers at large US healthcare organizations

Note: Percentages may not total 100 because of rounding.

Source: A commissioned study conducted by Forrester Consulting on behalf of IBM Healthcare, December 2019

## Appendix C: Related Research

“Now Tech: Enterprise Health Clouds, Q2 2019,” Forrester Research, Inc., May 21, 2019.

“The Forrester Wave: Enterprise Health Clouds, Q3 2019,” Forrester Research, Inc., September 11, 2019.

“How To Achieve The Healthcare Quadruple Aim With Artificial Intelligence,” Forrester Research, Inc., April 30, 2019.

“How To Build A Healthcare IoT Platform,” Forrester Research, Inc., March 22, 2019.

## Appendix D: Endnotes

<sup>1</sup> Base: 101 Infrastructure decision-makers working in healthcare.

Source: Forrester Analytics Global Business Technographics® Infrastructure Survey, 2019.

<sup>2</sup> Source: “Assess The Pain-Gain Tradeoff Of Multicloud Strategies,” Forrester Research, Inc., March 19, 2019.

<sup>3</sup> Source: “The US Healthcare Security Benchmark, 2018 To 2019,” Forrester Research, Inc., July 5, 2019.

<sup>4</sup> Source: “The Forrester Wave™: Enterprise Health Clouds, Q3 2019,” Forrester Research, Inc., September 11, 2019.

<sup>5</sup> Source: “HCOs Need To Double Down On Virtual Care And Interoperability In The Post-CVS–Aetna Era,” Forrester Research, November 30, 2018.

<sup>6</sup> Source: “The Forrester Wave™: Enterprise Health Clouds, Q3 2019,” Forrester Research, Inc., September 11, 2019.

<sup>7</sup> Source: “Lessons Learned From The Latest HIPAA Security And Privacy Incidents,” Forrester Research, Inc., July 31, 2019.