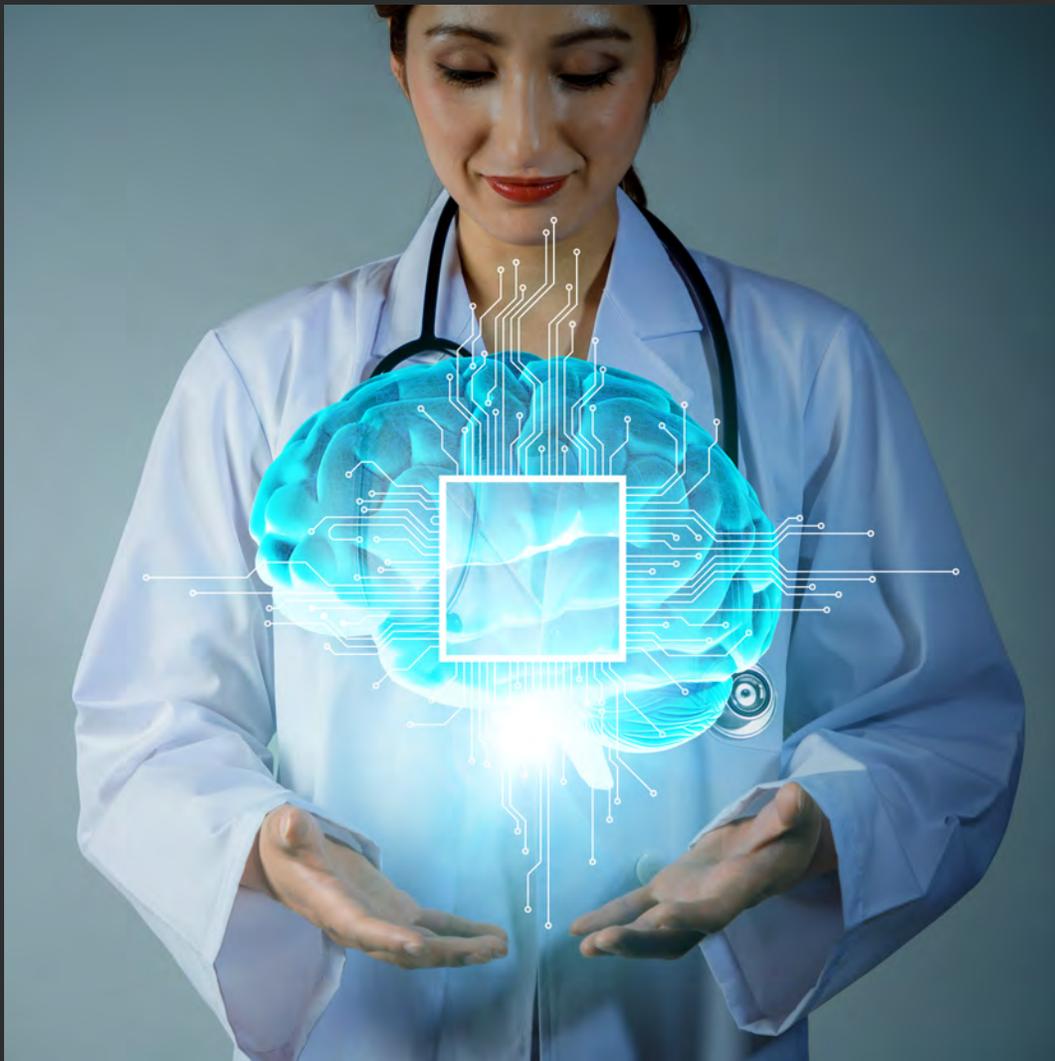


# Artificial intelligence in healthcare



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# 01

## Intro

Healthcare is drowning in data. An article by CIO.com outlines [How CIOs Can Prepare for Healthcare 'Data Tsunami.'](#) Data is coming from: digitization of healthcare information, EHR systems, precision and personalized medicine, health information exchanges, consumer health, IoMT (Internet of Medical Things), and other major trends.

AI (Artificial Intelligence) and ML (Machine Learning) are powerful tools that empower healthcare organizations to process the tsunami of healthcare data in near real time, maximize the value of this data, and deliver near real time insights that in turn enable healthcare to maximize the Quadruple Aim Objectives. Increasingly healthcare organizations run AI/ML workloads in the cloud to reduce costs, and improve security, agility, and scalability.

[Clinician burnout](#) is a major concern across healthcare providers with 42% of physicians indicating burnout in a recent research study by Medscape, and their job

is the major lifestyle factor, with too many bureaucratic tasks (for example charting, paperwork) cited as the major task factor. Too much healthcare data and administrative tasks around the processing of this data exacerbates these challenges. AI/ML can automate the processing of healthcare data and associated mundane tasks, in near real time, freeing up healthcare workers, empowering them with actionable insights, and enabling them to spend more time with patients.

Healthcare costs are skyrocketing. In 2016, [healthcare costs in the US are estimated](#) at nearly 18 percent of the GDP! Healthcare is becoming less affordable worldwide, and a serious chasm is widening between those that can afford healthcare and those that cannot. Cloud computing empowers healthcare with strategic, transformative new capabilities while enabling healthcare organizations to reduce costs.

Healthcare is struggling with cybersecurity as



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evidenced by frequent, large, high profile breaches and ransomware incidents. Cloud computing provides healthcare advanced tools and safeguards they can use to efficiently manage privacy and security, and achieve compliance with applicable regulations, security standards, and data protection laws.

This overview introduces AI in healthcare. It has two parts. The first is a high-level overview of the business values and use cases accelerating the adoption of AI in healthcare, and realization of the associated benefits. The second is an overview of the solution and deployment options. We showcase Microsoft partners specializing in AI, along with healthcare organization references. Finally, we draw several key conclusions regarding the value and practical application of AI in healthcare organizations, and the strategic transformative potential of this technology for the industry worldwide.

## Business value and use cases for AI in healthcare

AI and ML are needed in healthcare to process and maximize the **Quadruple Aims** benefits of massive and accelerating healthcare data streams. Healthcare—across providers, payers, pharmaceuticals, and life sciences segments—needs to fulfill the Quadruple Aim Objectives, which are:

1. Improving population health and patient outcomes
2. Reducing healthcare costs
3. Improving the patient experience, and patient engagement
4. Improving the healthcare worker experience, and reducing provider burnout

Several leading use cases for AI in healthcare are summarized below. These have emerged based on customer success stories and analyst research.

### Resource and Asset Optimization

Hospitals, clinics, and other providers can leverage data to better manage the use and maintenance of clinical and operational resources, including electron-

ic medical devices. Through analytics, machine learning, and IoT, organizations can optimize the use of assets by matching them with demand patterns. For example, by collecting and analyzing multiple sensor data from a medical device and combining it with usage data, a system can predict when a device requires maintenance. This use case includes a higher requirement for non-automated data preparation than other healthcare use cases.

### Readmission Prevention

Hospitals are seeking to reduce readmits by leveraging data from medical devices, clinical records, and other real-time data sources. Health payers and providers leverage analytics/ML/AI to identify patients who are at risk of being readmitted to the hospital after an initial discharge (for example, within 30, 60 and 90 days).

### Fraud, Waste, and Abuse Reduction and Prevention

Healthcare fraud costs payers and government agencies (e.g., Medicare & Medicaid Services) billions of dollars in annual losses in the U.S. alone; fraud represents a substantial portion of total annual spending on healthcare. Common areas of fraud include overbilling, repeated billings, fake prescriptions, repeated procedures, unnecessary or questionable lab tests, errors of medical coding, fictitious claims, and so on. Fraud is a major problem for providers, payers, and integrated payer-provider networks.

### Consumerization of Healthcare – Behavioral Analytics

Healthcare payers are ahead of providers in understanding the need to accurately profile healthcare consumer behaviors and target meaningful engagement to the right people at the right time—ensuring consumers stay as healthy as possible. The goal is to become more service-oriented, more consumer-oriented in healthcare, so a large payer combines claims data, clinical data, electronic health records, lab results, and other datasets (including patient-generated data from its website and call-center conversations, captured using natural language processing and speech analytics) into a single integrated data

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warehouse. Through machine learning algorithms, a payer creates a personal member profile that includes medical risks, etc. Analysts then identify specific characteristics and potential traits such as the risk for unnecessary emergency room visits or how well members are controlling their diabetes. These signals are shared with healthcare providers in the payer network.

## Medical Risk Analytics

This use case involves data, analytics, and machine learning/AI to predict or assess the risk of various medical needs associated with a specific disease condition. This type of analysis is interesting to both providers and payers (especially the Medicare Advantage Plans) and risk-bearing providers/accountable-care organizations. This is similar to the behavioral analytics use case—might even be considered a subset of the larger use case pattern.

## Claims Analytics

Specific to health insurance companies, claims analytics is the use of business intelligence and reporting solutions, dashboards, and data mining and predictive modeling technologies to improve, manage, and analyze claims data and performance. Overall, three components make up claims analytics: claims analysis, reporting, and predictive modeling.

*"Health organizations all over the world are looking to leverage the power of AI and the cloud to improve outcomes, accelerate performance, and enable the vision of precision medicine. "We are enthusiastic about the potential to foster multi-institutional collaborative environments for data sharing and machine learning," said Chuck Mayo, PhD at the University of Michigan Medicine. Microsoft is working to meet these challenges with Healthcare NEXt, an initiative which aims to accelerate healthcare innovation through artificial intelligence and cloud computing, while at the same time working to protect the privacy and confidentiality of patients."*  
Source: [Microsoft releases automation for HIPAA/HITRUST compliance](#)

# 02

## Solution overview

### Strategy

#### How Does AI/ML work?

The high level process used by AI/ML is as follows:

1. Ingest – import raw healthcare data into the AI/ML environment in the cloud for processing
2. Store – clean and securely store healthcare data in the cloud
3. Analyze – run AI/ML inference on raw healthcare data to yield insights
4. Interact – healthcare workers interact with AI/ML insights and healthcare data to draw conclusions and leverage results

Chronologically, raw healthcare data is ingested and used to train AI/ML models which are then used to analyze (run inference) on raw healthcare data to yield insights which healthcare workers can then interact with to gain new insights into the healthcare data and how best to treat patients.

#### Why Microsoft?

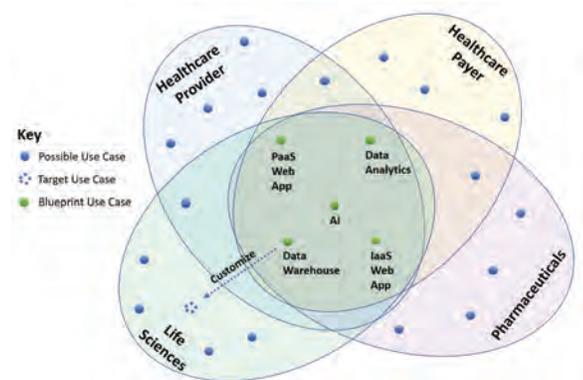
Microsoft Azure cloud offers healthcare an alternative for deployment of AI/ML that helps reduce costs, and provides improved security, agility, and scalability. AI/ML can be efficiently deployed in the Microsoft Azure cloud, and multiple **blueprints** are available to help healthcare organizations accelerate the adoption of AI/ML in the Microsoft Azure cloud. Healthcare organizations can download, configure, run, and customize these blueprints to bootstrap their own healthcare AI/ML initiatives.

To rapidly acquire new capabilities and implement new healthcare solutions, healthcare IT and developers can now take advantage of industry-specific solution blueprints created by Microsoft and partners. A blueprint is comprised of a package that includes documentation, executable code, and sample data built around a key use case of interest to healthcare. Blueprints also contain components to expedite privacy, security, and compliance initiatives. The components include

- threat models
- security controls
- responsibilities matrices
- compliance audit reports

- ... and other related tools.

A blueprint is not just documentation or a how-to guide. It also includes real, executable code and sample test data. With this package, a healthcare IT team can get a new type of solution up and running in their secure Azure cloud quickly. If this were a documentation-only package, any initiative would start from zero; developers would have to implement 100% of the solution. With a blueprint, they get 50%-90% of their end solution. They can concentrate on filling just the remaining 10-50%, with customization of the blueprint solution. The key is to minimize the gap between the blueprint you pick and your target use case as shown in the diagram below:



The steps to developing a customized solution from a blueprint are:

1. Pick the general blueprint closest to your target use case.
2. Update the architecture if needed. Typically, the architecture for your target use case will remain the same, or very similar, to the blueprint you pick.
3. Customize the solution installed using the blueprint to your target use case, including updating documentation.
4. Switch the test data to your data.

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5. Change any components as needed, for example, if you need a different database.
6. Blueprints may provide baseline privacy, security, and compliance support. Depending on your applicable regulations and data protection laws, as well as your specific privacy and security requirements, you may need to update privacy, security, and compliance for the solution installed from the blueprint to your requirements.
7. Implement any other changes required to meet your business and technical requirements.

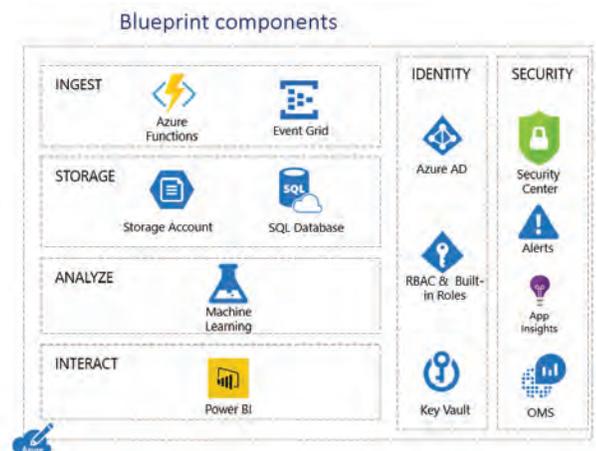
Microsoft Azure is well positioned vs competitors to realize this capability for healthcare due to:

1. **Extensive Microsoft healthcare team:** thousands of Microsoft employees worldwide with extensive, deep healthcare domain expertise, including doctors and nurses on staff. This team is already familiar with healthcare challenges, strategies, language, and with strong relationships across healthcare providers, payers, pharmaceuticals, life sciences, and business associates / data processors.
2. **Microsoft Azure hybrid cloud:** advanced hybrid solution that provides healthcare a flexible platform to adopt cloud on their terms. There are potential connectivity issues, for example in rural care, where Azure Stack on-prem deployment may be warranted. IoMT edge aggregation use cases may also warrant the use of a local Azure Stack instance. Last, but not least, regulatory or data protection law compliance requirements may make Azure Stack more suitable for some organizations and use cases than Azure cloud.
3. **Advanced AI/ML solutions for healthcare:** 5+ blueprints healthcare organizations can download, configure, run, and customize to accelerate the implementation with AI/ML in Azure, and the realization of the associated benefits.

## Technologies involved

Key regulations, standards, and technologies used in AI/ML running in the Microsoft Azure cloud:

1. Security and Compliance: HIPAA, HITRUST, [Azure AD](#), [Azure Key Vault](#), [Azure Security Center](#)
2. Interoperability: FHIR (Fast Healthcare Interoperability Resources)
3. Data Ingestion: [Blob Storage](#) and [Event Grid](#)
4. Storage: [SQL Database](#)
5. AI/ML: [Azure Machine Learning](#)
6. Business Intelligence: [Power BI](#) (Business Intelligence)
7. Operations: [Azure OMS](#) (Operations Management Suite)



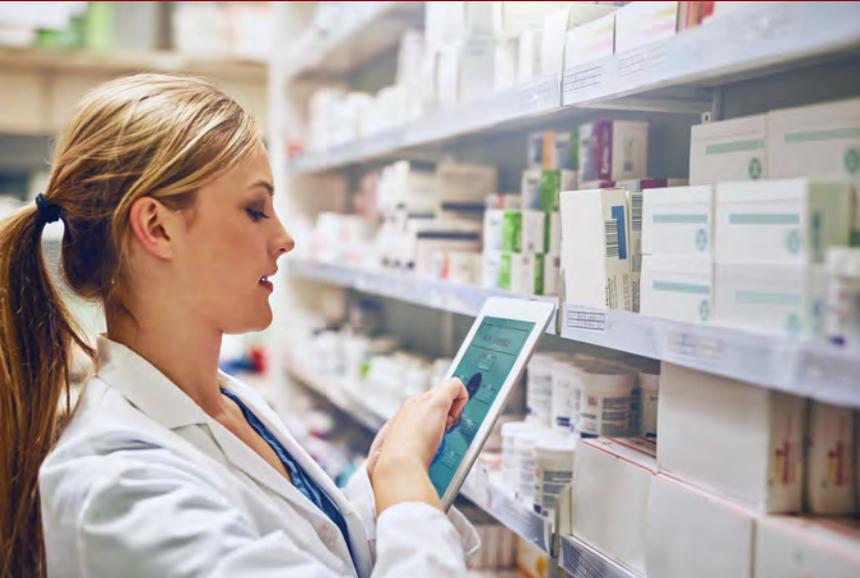
## Resources required

Key high-level resources required for healthcare organizations to leverage AI/ML in the cloud include:

1. Microsoft Azure Cloud - environment to deploy AI/ML
2. Technical Resources - capable of managing data flows and configuring cloud environments
3. Clinical Resources - to interact with AI/ML results and leverage results

# 03

## Should you build or buy?



Healthcare organizations use the cloud to get up and running quickly with AI and ML, improve agility and scalability, and address these capabilities as an operational expense, avoiding the need to procure and maintain expensive hardware and the associate IT and cybersecurity resources. When deploying AI and ML to the Azure cloud there are two high-level options:

### 1. Build your own

This option gives the healthcare organization more control. However, it requires the healthcare organization to have a team of experienced IT professionals savvy with building and operating AI and ML infrastructure.

### 2. Use a partner

This option enables the healthcare organization to focus more on healthcare and the use case and application layer of AI and ML rather than infrastructure. It can also accelerate realization of the benefits of AI/ML since the partner solution gives healthcare organizations a head-start when compared to building this capability from the infrastructure layer.

After scoping requirements for an AI/ML initiative it is recommended that healthcare organizations survey available partner solutions to see what they can leverage to expedite their onboarding of these capabilities and realization of the associated healthcare benefits. Different partners may offer solutions that help with parts of the AI/ML scope, so it may also be beneficial for a healthcare organization to engage multiple partners to help with different aspects of their AI/ML initiative. Partner solutions and services may include: PaaS AI/ML solutions, consulting services, privacy / cybersecurity / compliance services, or other. Wherever possible, for either a build-your-own, or partner deployment option the [blueprints](#) discussed in this overview can be used to accelerate AI initiatives.

# 03

## Partner showcase



Archive360 is a Microsoft Co-Sell Prioritized global ISV focused on data estate modernization. Archive2Azure for Healthcare is a 100% Azure-powered platform for intelligent, open-standard information management. Archive2Azure delivers long-term, secure, and cost-effective onboarding/migration, retention, and management of 100+ types of organizational data (including DICOM)—stored in its native format in YOUR tenant and secured with YOUR keys—with audited compliance, role-based access policies, and dynamic data analysis with Machine Learning, Artificial Intelligence, Media Services, and Cognitive Services.

Archive360 is a Microsoft Cloud Solution Provider and the Archive2Azure(TM) solution is Microsoft Azure Certified. Archive360 is a partner on the [Azure Security and Compliance Blueprint - HIPAA/HITRUST Health Data and AI](#). See this [quote from the CTO](#).

See [Archive360 on AppSource](#).



Ayan Consulting Services

Organizations and government agencies leveraging Azure cloud platform are trying to grasp the complexity associated with cloud. They are stressed about governance and compliance of extraordinarily complex systems and the demand for protections against cybersecurity attacks. Ayan Corp (both its consulting arm and its ISV business unit, [Cloudneeti](#)), are dedicated to enabling customers for an easy, effective and efficient transformation to automated security and compliance monitoring of Azure and Office 365 workloads, thereby providing safe, secure and compliant usage of Cloud Computing technologies.

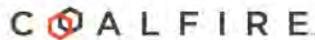
Ayan Consulting Services have a strong healthcare consulting practice and directly collaborated with Microsoft on creating the [Azure Security and Compliance Blueprint - HIPAA/HITRUST Health Data and AI](#) solution.

<http://aka.ms/Cloudneeti> on Azure Marketplace.



Founded in 1976, CGI is one of the world's largest IT and business consulting services firms, helping clients achieve their goals, including becoming customer-centric digital organizations. CGI has been a leader in healthcare claims auditing and recovery of improper payments since 1990. Our CGI ProperPay solution and services for reducing claims fraud, waste and abuse (FWA) have helped government and commercial payers recover more than \$2.8 billion in lost payments due to improper claims. CGI ProperPay employs artificial intelligence (AI) and machine learning (ML) in the secure Microsoft Azure Cloud to efficiently and effectively detect, remedy and prevent claims fraud, on both a pre- and post-payment basis.

See [CGI ProperPay on AppSource](#).



As the assessor for the world's largest cloud service providers, healthcare organizations rely on Coalfire for our deep understanding of cloud technologies and ability to help them navigate cybersecurity needs and meet compliance requirements. We partner with organizations using an approach that identifies challenges, then designs and operationalizes a customized governance framework to effectively manage security in the cloud to achieve desired outcomes. We evaluate the current state of governance and seamlessly integrate mature elements of existing structures into a future framework that optimizes value and performance, reduces risk and assures the effective use of resources in managing cloud security programs. Coalfire has a strong healthcare security, risk and compliance practice and directly collaborated with Microsoft on creating the [Azure Security and Compliance Blueprint - HIPAA/HITRUST Health Data and AI](#) solution. Learn more: "[Cloud Security Governance - Optimizing the Business Benefits of Security in the Cloud](#)".

<https://www.coalfire.com/>



KenSci is a partner on the [Azure Security and Compliance Blueprint - HIPAA/HITRUST Health Data and AI](#). See [this quote](#) from CTO. At KenSci we are fighting Death with Data Science. KenSci's Machine Learning Platform and Predictive Analytics Apps answer the hard questions about 'Who might get sick?', "What can we do about it?" and 'How can we serve them better across the continuum of care?'. We are a team of Doctors, Data Scientists and Developers are focused on building the first vertically integrated Machine Learning Platform for Healthcare. Join us on this exciting quest!

See [KenSci on AppSource](#)

# 04

## Next steps

AI holds great potential to help healthcare meet the [Quadruple Aim Objectives](#). To acquire and implement this capability and realize its benefits quickly and efficiently healthcare organizations can use the Microsoft Azure cloud, Microsoft partners, and AI blueprints for healthcare. Microsoft partners can help with:

1. Platforms and Solutions,
2. Services including:
  - a. Consulting
  - b. Systems integration
  - c. Privacy/security/compliance

Get started now by downloading the [AI for healthcare blueprint](#). I post regularly on new developments in AI and cybersecurity for healthcare. You can find me on [LinkedIn](#) and [Twitter](#). Reach out and connect and watch for updates on a wide range of resources and learning opportunities to help you accelerate your healthcare AI initiative. If you are a healthcare organization interested in collaboration around AI in healthcare, or if you provide services or solutions for healthcare organizations and would like to explore opportunities for collaboration please reach out to me at [David.Houlding@Microsoft.com](mailto:David.Houlding@Microsoft.com).

Continue your journey with AI and healthcare, and learn more with these resources:

- Access further resources, partner information and technical resources through the [AI in healthcare overview](#)
- Learn more about Microsoft's investment in healthcare solutions on the [Azure for healthcare website](#)
- Stay up to date with all the [healthcare industry news](#) focused on cloud transformation with Azure.