

EBOOK

Improving Health Outcomes With Data and AI

Accelerate innovation in research and care with the
Data Intelligence Platform for Healthcare and Life Sciences



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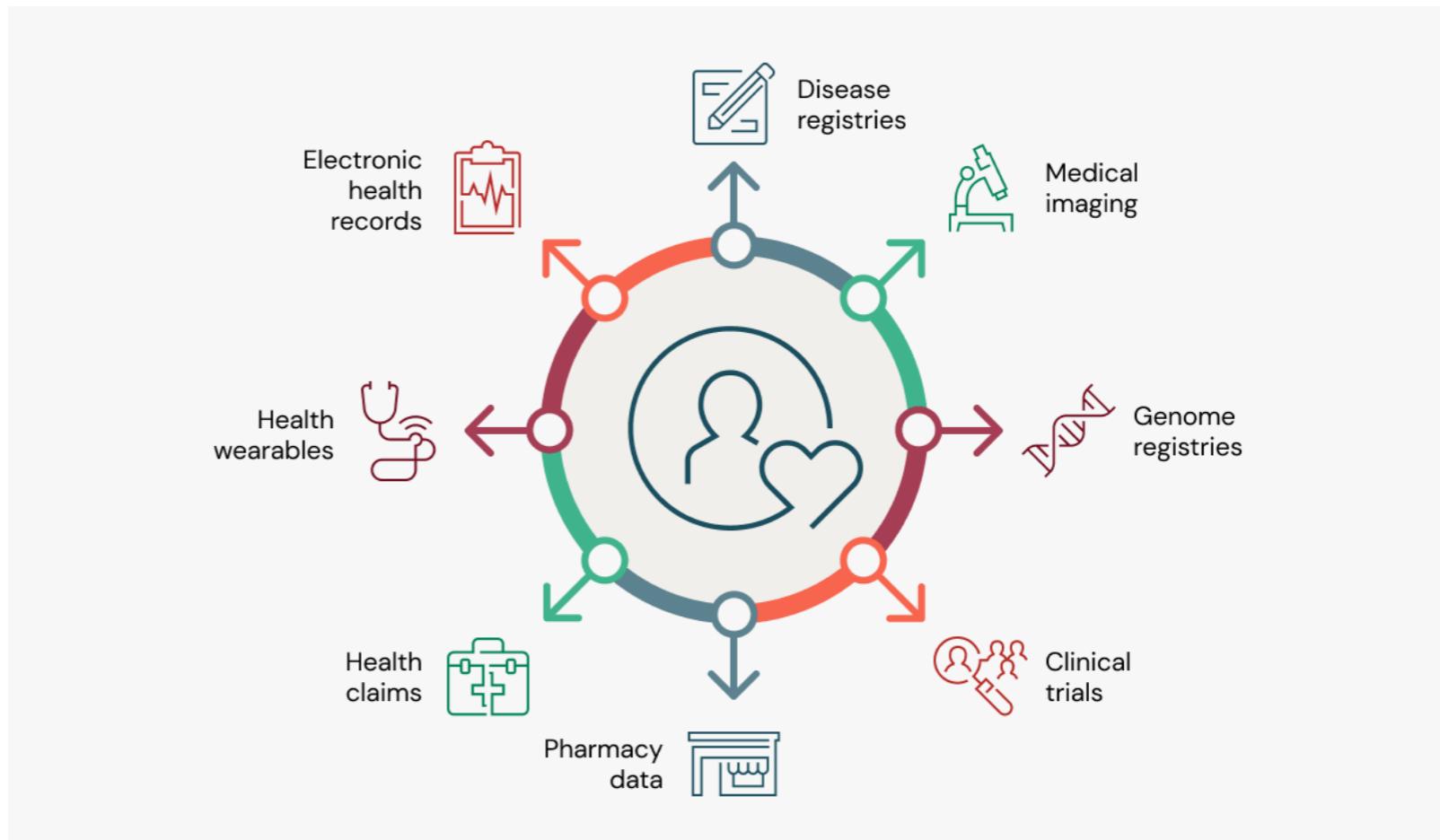
INTRODUCTION

An Industry in Flux: Patient-Centric and Data-Driven

More than most industries, healthcare and life sciences has been constantly revolutionized by technology. Rapid advances in diagnostics, patient care and drug development have led to remarkable progress in improving patient outcomes and treating diseases — but there's still so much more to do.

Over the last decade, organizations across the health ecosystem have placed a major emphasis on lowering the cost of care and improving patient outcomes. Delivering on this promise requires a holistic view of the patient and innovation at every level, from drug discovery to the delivery of care.

Now we're on the cusp of a breakthrough in healthcare and life sciences. The explosion of digital technologies — such as electronic medical records, genome sequencers, IoT sensors, wearables and medical imaging — has ushered in a new era of big data. IDC estimates approximately 270 GB of healthcare and life science data is created for every person in the world ([source](#)). Add in all the other types of health-related data such as wearables, claims and genetics and the number is staggering. It's no surprise that the average healthcare provider is generating over [50 petabytes of digital information annually](#). This data, while large and unwieldy, is critical to building a holistic view of the patient. By bringing this data together, organizations can better understand the factors that contribute to a positive or negative health outcome.



The key is making sure that teams that need this data have it at their fingertips — along with the analytics and machine learning tooling necessary to unlock innovative use cases. The need for a modern data analytics and AI platform has never been greater, driven by tectonic market shifts — many driven by the global pandemic.

Healthcare and Life Sciences Transformation Trends

Healthcare is in a state of change and today's most successful organizations are tapping into the power of data and AI to respond to these five tectonic shifts:

TREND #1:

Increasing Regulatory Pressure for Interoperability

Healthcare interoperability is at the center of all transformation initiatives as it enables different IT systems to exchange health information. Simply put, interoperability and data sharing is table stakes for building a holistic view of the patient across all of the systems that hold that data today.

Pressure from regulators to adopt industry standards for interoperability is on the rise. For example, the 21st Century Cures Act, passed by the U.S. Congress in 2016, requires every payer and provider to make health data accessible via real-time APIs. Additionally, the U.S. Centers for Medicare & Medicaid Services (CMS) made the Fast Healthcare Interoperability Resources (FHIR) its standard for data exchange, helping drive adoption across the industry. And it's not just in the United States. Similar global regulations and the adoption of FHIR are helping to unlock interoperability across borders.

Furthermore, healthcare data is exchanged through myriad other standards – Electronic Data Interchange (EDI) for claims, flat files (CSV) for member data, DICOM for medical images, HL7v2 for Admit, Discharge, and Transfers (ADT).

All organizations — whether they are looking to innovate drug R&D or patient care — need to consider how their data platforms support these standards and work toward data consolidation internally and with their partners.

DATA AND AI IN ACTION

Providence, an integrated delivery network (IDN) with more than 50 hospitals in the United States, streams messages from Epic electronic health records (EHR) and other on-prem systems providing real-time information about every patient in the hospital system. Not only are providers spending more time with patients, they improved NEDOCS scores across Emergency Departments in their 51 hospitals.

TREND #2: Growing Acceptance of Real-World Evidence

Real-World Evidence (RWE) is generated from any data collected outside a clinical trial, such as claims, clinical notes and medical images. This data, called Real-World Data (RWD), has huge potential to provide new insights into the usage, effectiveness and risks of a drug.

Regulators around the world recognize the benefits of RWE. The U.S. Food and Drug Administration published [guidance](#) in September 2021 on the proper use of real-world data. This builds on the 21st Century Cures Act, which signaled U.S. regulatory acceptance of RWE back in 2016. In Europe, the Heads of Medicines Agencies – European Medicines Agency (HMA-EMA) are working on similar [initiatives and workshops](#) to govern the proper use of real-world data.

With RWE entering the mainstream, life sciences organizations need to invest in flexible data platforms that support unstructured RWD, and data standards (e.g., OMOP common data model) to facilitate population-level analysis. Additionally, RWE requires governance with lineage for all data transformations so regulators can recreate analyses. Organizations adopting RWE need to ask if their data platforms provide this level of transparency.

DATA AND AI IN ACTION

[Amgen](#) modernized its data architecture, eliminating disjointed data platforms that prevented collaboration across thousands of data analysts, engineers, and scientists. By bringing in all of their data, including RWE, into Databricks, Amgen has delivered 300 cross-functional analytics and ML projects that improve drug efficacy and predict safety issues, saving \$ millions in clinical trial costs and infrastructure costs.

TREND #3: Advancements in Personalized Medicine and Prevention

The pace of personalization in healthcare and life sciences is accelerating. Consider: The first human genotype cost more than \$1B to sequence. Today, individual whole-genome sequencing is available to consumers via mail for \$300. And in 2024, the UK Biobank confirmed [whole genome sequencing data on all 500,000 participants](#) for research.

Genomic analysis is essential for drug development and increasingly important in informing patient care. In short, genomics is core to personalization. Like genomic data, image data is also becoming more readily available and is essential to the diagnosis and treatment of the fastest-growing therapeutic areas such as oncology, immunology and neurology.

Another major trend in personalized care are liquid biopsies. These tests are done on samples (typically blood) to detect the presence of disease markers. Early, noninvasive detection is one of the best approaches to managing cancer and will likely grow in importance.

With all these advancements in personalized care, healthcare and life sciences organizations should expect patient data to grow tremendously in the future.

DATA AND AI IN ACTION

In the 18 months since its founding, [Exai Bio](#) has performed analyses spanning 12 cancers and over 10,000 subjects, building one of the largest smRNA sequencing dataset and oncRNA profiles in cancer and general populations.

TREND #4: Displacement and Digitization of Patient Care

Accelerated by the pandemic, the displacement of care from traditional settings — like primary care offices and hospitals — to the pharmacy and home, is on the rise. At the same time, the digital health market, experienced both through telemedicine as well as wearable devices, is back to pre-pandemic levels and continuing to grow in adoption.

Innovative technologies and services are becoming the norm as we move to virtual care settings. Underpinning these initiatives is the need for data platforms that can collect, curate and analyze streaming patient data in real-time.

DATA AND AI IN ACTION

[CVS Health](#), for example, has a much better idea of who their customers are and what their needs are in the moment by leveraging a breadth of data about a person. They can measure the probability of buying a particular product, or when to remind a patient to fill or pick up their medication, and even identify potential side effects the patient may be experiencing. The results of boosting personalization at CVS Health include a 1.6% improvement in medication adherence, meaning an increasing number of patients are now taking their medication on time and as directed.

TREND #5: Unpredictable Demand and Supply Chain Disruptions

Perhaps more so than other industries, COVID-19 upended the historical dynamics of supply and demand in healthcare. Providers witnessed unmanageable spikes in ICU bed demand, nursing shortages, and massive gaps in COVID-19 diagnostic tests.

At the same time, the BioPharma industry has grappled with the challenges of an inadequate cold chain ill-equipped for mass vaccine distribution. Most organizations struggle to even do real-time reporting on data from legacy systems like SAP and Oracle ERP, creating gaps in inventory moving through distribution centers.

DATA AND AI IN ACTION

[Johnson & Johnson](#) reinvented the supply chain with real-time forecasting and product tracking. Identifying and mitigating bottlenecks led to a 50% reduction in costs, and data delivery was reduced from 24 hours to 10 minutes.

Barriers to Data-Driven Innovation

There's no shortage of data or the need for data-driven innovation. Yet, most healthcare and life sciences organizations struggle to tap into the full potential of data and AI. There are five common challenges hindering their success:

CHALLENGE #1: Scaling for rapidly growing health data

Healthcare data is growing exponentially. For example, just one human genome sequence produces approximately **200 gigabytes** of raw data. Multiply this across millions of patients and that number is massive. And it's not just genomics data that is huge. A single individual is expected to generate a staggering **1 million gigabytes of health-related data** in their lifetime. This includes clinical data, imaging health wearables and more.

Unfortunately, legacy on-premises data architectures are complex to manage and costly to scale for today's massive volumes of healthcare data. Scaling analytics across large population data sets is nearly impossible with today's limitations, inhibiting innovations in care and research.

CHALLENGE #2: Building a holistic view of the patient

Healthcare and life science organizations deal with a tremendous amount of data variety, each with its own nuances. It is widely accepted that over 80% of medical data is unstructured, yet most organizations still focus their attention on data warehouses designed for structured data and traditional SQL-based analytics.

In the context of healthcare, unstructured data includes medical images, which are critical to diagnose and measure disease progression, and narrative text in clinical notes, which are critical to understanding the complete patient health and social history. Ignoring these data types, or setting them to the side, is not an option.

Some organizations have invested in data lakes to support unstructured data and advanced analytics, but this creates a new set of issues. In this environment, data teams need to manage two systems — data warehouses and data lakes — where data is copied across siloed tools resulting in data quality and management issues. Without a unified platform for all data, organizations cannot create a holistic view of patient health.

CHALLENGE #3: Delivering real-time insights

Healthcare decisions can be a matter of life and death, and health conditions can change quickly. Weekly or daily batch data processing — which is commonplace for most organizations — is not good enough. Access to the latest, up-to-the-second information is critical for interventional care. Streaming data needs to be made available for everything from predicting sepsis to real-time forecasting of ICU bed usage.

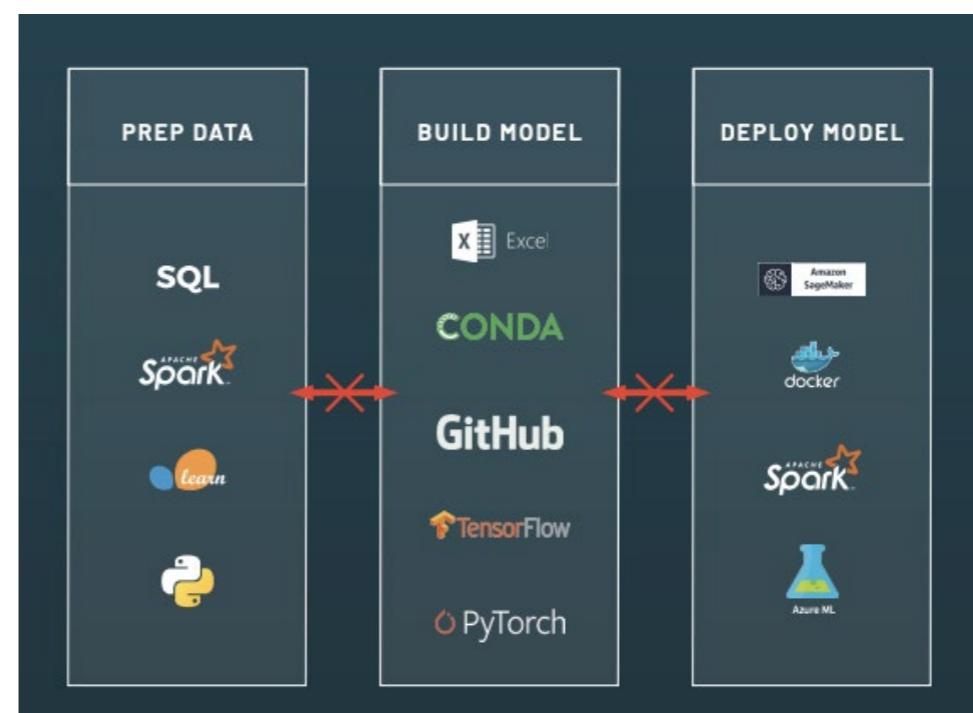
The use cases for real-time data extend to life sciences as well. Consider temperature sensitive medications like vaccines. Streaming data from IoT sensors is critical to monitoring the production, storage and transportation of these life-saving treatments. An unnoticed outage of refrigeration equipment along the distribution line can mean those in need never receive their medication.

Unfortunately, traditional data platforms, such as data warehouses, were not designed to operate in real time. And disconnected platforms for data processing, analytics and AI further slow down the analysis and dissemination of critical information.

CHALLENGE #4: Overcoming the complexities of ML

Big data and machine learning have demonstrated their promise in enhancing multiple areas of care and pharmaceutical research, such as population health and precision medicine. Unfortunately, many organizations still struggle to embed ML within their operations.

The challenges are twofold. For one, the legacy analytics platforms that underpin healthcare and pharma organizations typically lack robust data science capabilities. Secondly, the tools used in machine learning are complex and hard to manage. Organizations brave enough to build a modern data science architecture need to support the many open source frameworks (TensorFlow), libraries (matplotlib), scripting languages (R, Python, Scala or SQL) and IDEs (JupyterLab, RStudio) that data science teams require at each stage of the machine learning lifecycle.



CHALLENGE #5: Ensuring clinical data governance and reproducibility

With patient lives on the line, clinical and regulatory standards demand the utmost level of data accuracy. Healthcare and life sciences organizations are required to meet stringent public health compliance requirements. Data that is used to inform healthcare decisions must be tracked, transparent and well-governed. Additionally, organizations need good model governance when bringing machine learning into a clinical or research setting.

Unfortunately, most organizations have separate platforms for data science workflows that are disconnected from their data warehouse. Data is copied across systems and then transformed to meet the needs of the requesting team. This creates significant data lineage challenges when trying to build trust and reproducibility in AI-powered applications.

CHALLENGE #6: Adapting to breakthrough technologies like Generative AI (GenAI)

The explosive growth of ChatGPT has influenced every industry to reexamine their artificial intelligence (AI) strategies. While healthcare & life sciences has been exploring the use of data and AI to improve patient care, medical research, and clinical decision-making for years, large language models (LLMs) has elevated AI to a strategic initiative healthcare leaders can no longer ignore.

How healthcare leaders are thinking about GenAI today

91%
of organizations are experimenting or investing in GenAI¹



61%
plan to grow their spending on data and AI up to 25% over the next year¹



[Read the MIT Technology Review Report](#)

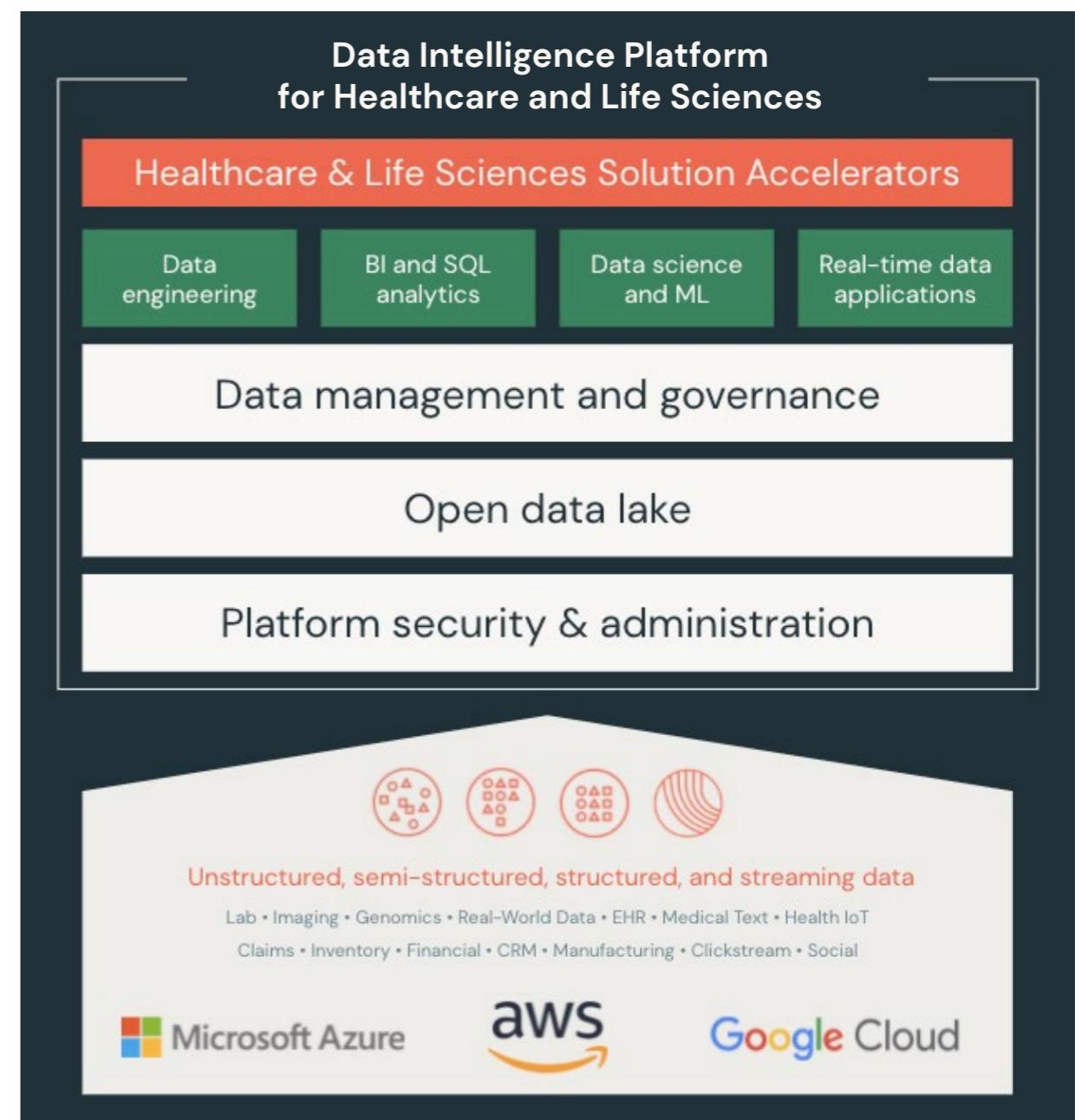
¹ [Bringing breakthrough data intelligence to industries](#)

Unlocking Innovation With the Data Intelligence Platform for Healthcare and Life Sciences

For your data-driven transformation, there is a path forward — introducing the Databricks Data Intelligence Platform for Healthcare and Life Sciences.

The Databricks Data Intelligence Platform for Healthcare and Life Sciences enables organizations across the health ecosystem to work together to improve health outcomes with a single and collaborative platform for data, analytics and AI. With these capabilities, organizations can leverage all their data to build a holistic view of the patient, make real-time decisions and drive innovation with advanced analytics.

Building on this foundation are **Solution Accelerators** for common analytics and AI use cases. These solutions are developed by Databricks and our ecosystem of partners to accelerate the delivery of analytics projects and provide measurable outcomes.



PLATFORM BENEFITS

Infinite scale for population-level studies

Built in the cloud and designed for high performance, the Data Intelligence Platform for Healthcare and Life Sciences supports the largest of data jobs at lightning-fast speeds. For example, [Regeneron](#) reduced data processing from 3 weeks to 5 hours, and genotype-phenotype queries from 30 minutes to 3 seconds for workloads that scaled to 1.5M exomes. With these capabilities, organizations can quickly and reliably analyze data for millions of patients.

DIFFERENTIATED CAPABILITIES:

■ Performance at scale

With Apache Spark™ and Delta Lake — the leading open source engines for large-scale data processing and data management — under the hood, lakehouse architecture delivers massive scale and speed. And because it's optimized with performance features like indexing and caching, Databricks customers have seen ETL workloads execute [48x faster](#).

■ Elastic compute

Scalable cloud compute resources are available at the click of a button to meet the demands of any size job. Autoscaling clusters scale up or down based on the size of your workload so you only use as much processing power as needed to meet the demands of your workloads.

360° view of the patient

Unify all your data — patient, R&D and operations — in a single platform to unlock innovations in personalized care and therapeutic design. Unlike a traditional data warehouse, lakehouse architecture supports all types of structured and unstructured data enabling organizations to build a holistic view of patient health. To make data curation easy, Databricks and our partners built data ingestion tools for domain-specific data types.

DIFFERENTIATED CAPABILITIES:

■ All data types

Support for all types of structured, unstructured and semi-structured data with Delta Lake and Apache Spark™ at the foundation. And with Delta UniForm (short for Delta Lake Universal Format), data teams can easily implement, seamless unification of table formats without creating additional data copies or silos.

■ Ingestion and curation Solution Accelerators

Databricks and partners like John Snow Labs provide a suite of notebook templates that make it easy to ingest common data formats, such as HL7 messages, FHIR bundles, medical text and imaging. Lakehouse architecture also supports common data models such as OMOP for real-world data. Through the use of Large Language Models (LLMs), additional business value can be created through various use cases from AI Chatbots to text translation and summarization.

■ Open formats and open data sharing

Data is stored in Delta Lake using an open source data format that prevents vendor lock-in. Additionally, Delta Sharing provides an open source data-sharing capability that promotes collaboration.

Delta sharing technology is changing how our customers interact and leverage IQVIA data to get more value with less effort. In collaboration with Databricks, Life Sciences organizations can now access the unparalleled value of IQVIA data in the Databricks Marketplace, empowering our customers to gain invaluable insights for informed and impactful transformations.

BILL ZANINE

Vice President – Product Development
– Information & Analytic Services, IQVIA

Real-time insights for real-time operations

In no other industry, are real-time insights more critical than healthcare. Take advantage of rapid data ingestion at scale to support real-time analytics use cases from interventional care (e.g., predicting sepsis) to optimizing supply chains on the fly.

DIFFERENTIATED CAPABILITIES:

- **Real-time data ingestion**

Lakehouse architecture allows for true real-time stream ingestion of data, and even analytics on streaming data. Standalone data warehouses require the extraction, transformation, loading, and then additional extraction from the data warehouse to perform any analytics.

- **Simplified streaming and batch architecture**

The lakehouse event-driven architecture provides a simpler to develop and manage method of ingesting and processing batch and streaming data than legacy approaches, such as lambda architectures. This architecture handles the change data capture and provides ACID compliance to transactions.

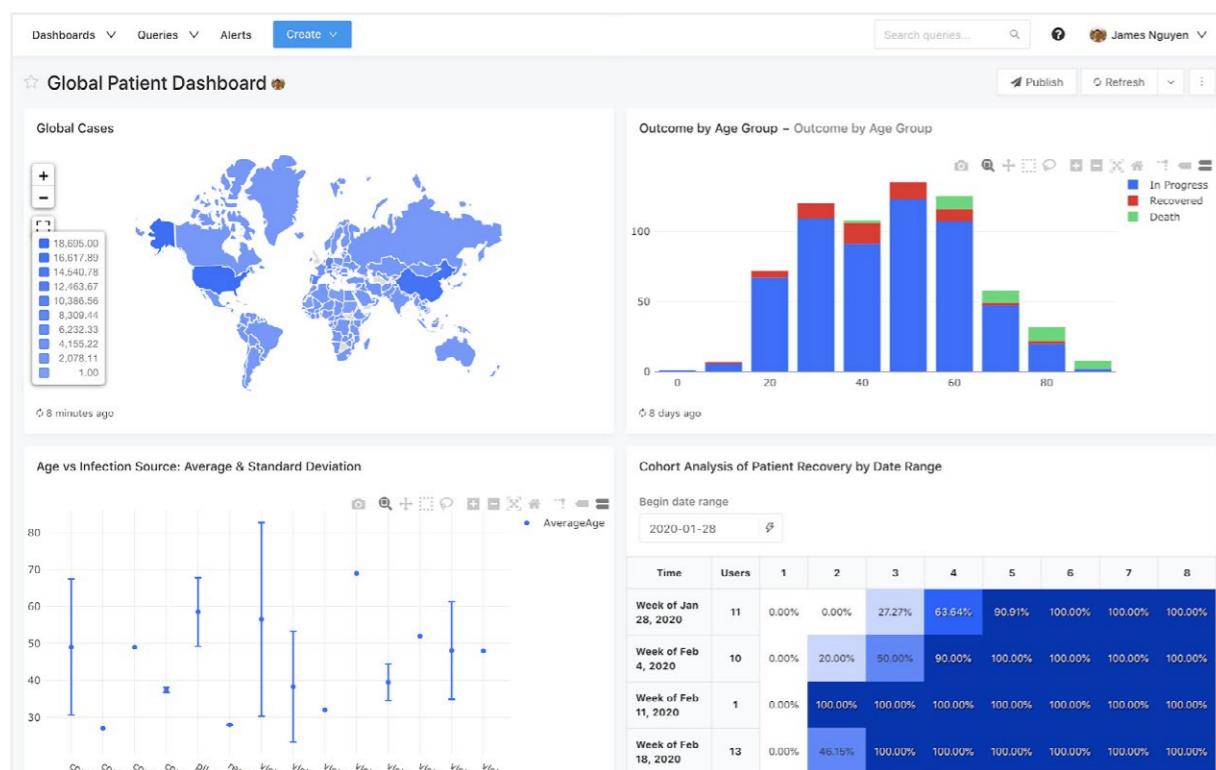
- **Interoperability Solution Accelerators**

Solution Accelerators and open source libraries — such as Smolder for HL7 messages — built by Databricks and our ecosystem of partners support real-time patient insights.

For example, **Providence** has improved hospital operations by analyzing streams of messages from Epic electronic health records (EHR) and other on-prem systems to in an effort to mitigate overcrowding across Emergency Departments in their 51 hospitals. **Johnson & Johnson** has been able to unify all their data sources under a lakehouse architecture —helping them to scale supply chain analytics alongside business needs.

ML-powered drug discovery and patient care

Unlock the power of machine learning to better understand disease and predict health needs. With all your data centralized and seamlessly connected with a full suite of collaborative analytics and machine learning tools, data teams can work together to build powerful predictive models that drive new innovations in care delivery and drug research.



Collaborative data science

The lakehouse provides an interactive notebook environment that enables cross-functional teams — including data scientists, engineers, researchers, clinicians and business analysts — to collaborate on data products with a wide range of analytics and ML capabilities, including support for multiple languages (R, Python, SQL and Scala) and popular ML libraries.

Publish powerful dashboards

Make insights consumable with interactive visualizations and publish as dashboards to teams in the field — be it in the ER or conducting clinical research — so they can stay abreast of the latest findings.

Easily manage the ML lifecycle

Manage the complete ML lifecycle from model development through deployment with Managed MLflow, an open source platform developed by Databricks to help streamline machine learning. Centralize models and features in the registry to help teams collaborate, iterate and reuse existing work.

Analytics and AI Solution Accelerators

Solution Accelerators built by Databricks and our partners help teams deliver value faster with quick-start notebook templates. Solutions are available in a number of areas including medical image analytics, healthcare natural language processing, drug R&D, and population health.

For example, at [Biogen](#), disease biologists are now able to deepen their understanding of genetic variants, human longevity, and neurological statuses to develop therapies and treatments for patients around the world. And [CareSource](#) is leveraging data and AI to help mitigate dangerous pregnancies by identifying high-risk mothers who need special care.

Healthcare analytics you can trust

Deliver analytics and AI with data governance, lineage and model reproducibility. The Databricks Platform includes capabilities missing from traditional data lakes like schema enforcement, auditing, versioning and fine-grained access controls. This helps bring data governance to your big data projects.

An important benefit of lakehouse architecture is the ability to perform both analytics and ML on this same, trusted data source. Additionally, Databricks provides ML model tracking and management capabilities to make it easy for teams to reproduce results across environments and help meet compliance standards. All these capabilities are provided in a secure analytics environment.



“

The Databricks platform is enabling everyone in our integrated drug development process – from physician-scientists to computational biologists – to easily access, analyze, and extract insights from all of our data.

”

JEFFREY REID

Chief Data Officer, Regeneron Genetics Center

SOLUTION ACCELERATORS

Databricks and our ecosystem of partners have packaged Solution Accelerators to help organizations derive value from their lakehouse projects faster.

- **Data Ingestion and Curation Tools:** Easily ingest domain-specific data modalities into your lakehouse and prepare for analytics at scale with common data models like OMOP.
- **Analytics and AI Templates:** Quick-start templates for high-value analytics and AI use cases, such as digital pathology, genetic association studies, and drug repurposing.

As a data-driven business, Databricks has given us an advantage in the marketplace because we're able to see insights across 30 health systems and growing. The value of that asset, not only for us and our clients, but for the industry is going to be vast.

GRANT VEAZEY

Chief Technology Officer, Ensemble Health Partners

Featured Partner Solutions



Ingest **HL7, FHIR Bundles, and Medical Images** in minutes, not months

Unlock electronic health record (EHR) data and accelerate real-time hospital operations



Accelerate your **Customer 360** initiatives

Drive intelligent next-best action (NBA) to increase commercial effectiveness



Natural Language Processing (NLP) for Healthcare + LLMs

Extract insights from unstructured text for use cases such as PHI removal, adverse drug event detection, and oncology evidence generation.



Unlocking untapped potential in **life sciences R&D**

Harness Scientific AI to bring more effective and safer therapies to market faster and less expensively

Real Examples of Data Intelligence Success

Healthcare and life sciences organizations are unified around a single goal: improve health outcomes. The role of data and AI in delivering on that mission has never been more critical.

The Data Intelligence Platform for Healthcare and Life Sciences is enabling organizations across the health ecosystem to collaborate and unlock data-driven innovation from drug discovery through patient care and beyond.

 <p>Migrated data for 10,000 stores from Hadoop to Databricks to build personalization models at scale that increased medication adherence by nearly 2%, improving the quality of life for their pharmacy customers.</p>	 <p>Analyzed 2 million genomic variants on Databricks in under 15 minutes. This research led to the discovery of 2 new drug targets for neuro-degenerative diseases like Alzheimer's and Parkinson's.</p>	 <p>Streams messages from Epic electronic health records (EHR) and other on-prem systems providing real-time information about every patient in the hospital system, improving NEDOCS scores across Emergency Departments in their 51 hospitals.</p>
 <p>Applied machine learning to 17M+ electronic health records to identify new treatment indications for approved therapies while reducing data processing costs by 30%.</p>	 <p>Built one of the most comprehensive genetics databases on Databricks with 1M+ exomes. Reduced data processing time from 3 weeks to 5 hours and accelerated genotype-phenotype queries by 600%.</p>	 <p>Saving Mothers with ML: CareSource powers data intelligence and MLOps with Databricks, improving outcomes in high-risk obstetrics patients.</p>
ASTRAZENECA BAYER ORACLE HEALTH (Formerly Cerner) GLAXOSMITHKLINE (GSK) MERCK	NOVO NORDISK WELLDOK GENOMIC INSTITUTE OF SINGAPORE CRISP HIE	PROVIDENCE HEALTHGRADES SCAN HEALTH PLAN AUSTIN HEALTH

About Databricks

Databricks is the data and AI company. More than 10,000 organizations worldwide – including Amgen, Providence, Humana and over 60% of the Fortune 500 – rely on the Databricks Data Intelligence Platform to unify and democratize data, analytics and AI. Databricks is headquartered in San Francisco, with offices around the globe, and was founded by the original creators of Lakehouse, Apache Spark™, Delta Lake and MLflow. To learn more, follow Databricks on [LinkedIn](#), [X](#) and [Facebook](#).

**Get started with a free trial of Databricks
and start building data applications today**

[START YOUR FREE TRIAL](#)

To learn more, visit us at:

[Data Intelligence Platform for Healthcare and Life Sciences](#)

