



White Paper

# Healthcare Data Platforms for Advanced Analytics

## Abstract

The healthcare industry is facing growing challenges in improving patient outcomes while optimizing operational efficiency. This paper explores the transformative potential of data-driven insights in achieving these dual objectives leveraging advanced analytics, to generate actionable intelligence from vast and complex datasets

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# Healthcare Data Platforms for Advanced Analytics

## INTRODUCTION

The healthcare landscape is undergoing a data-driven revolution. The adoption of digital platforms and cloud technology promises a future of optimized workflows, efficient resource allocation, and, ultimately, improved patient outcomes. However, a critical roadblock remains data fragmentation. Valuable information resides scattered across disparate systems, hindering its full potential to empower informed decision-making.

Our innovative Data Analytics Framework tackles this very challenge. It acts as a unifying bridge, seamlessly integrating data from various on-premises and cloud applications, regardless of their initial location. This meticulous process is orchestrated through a thoroughly curated and dependable data pipeline, ensuring the security and integrity of both structured and unstructured healthcare data.

Imagine a platform where siloed information transforms into a unified stream of actionable insights. Our framework leverages this clean, integrated data to fuel powerful analytical tools. Data science, machine learning, and advanced analytics applications unlock hidden patterns and trends, revealing previously unseen opportunities for improvement.

The culmination of this data transformation manifests in intelligent, interactive dashboards. These intuitive interfaces provide real-time visibility into crucial patient care metrics and operational processes. From predicting patient needs to optimizing resource allocation, healthcare providers gain the power to make data-driven decisions that directly impact patient well-being and operational efficiency.

Our framework extends beyond mere data aggregation. It comprises three key components, each meticulously designed to address the specific needs of the healthcare industry:

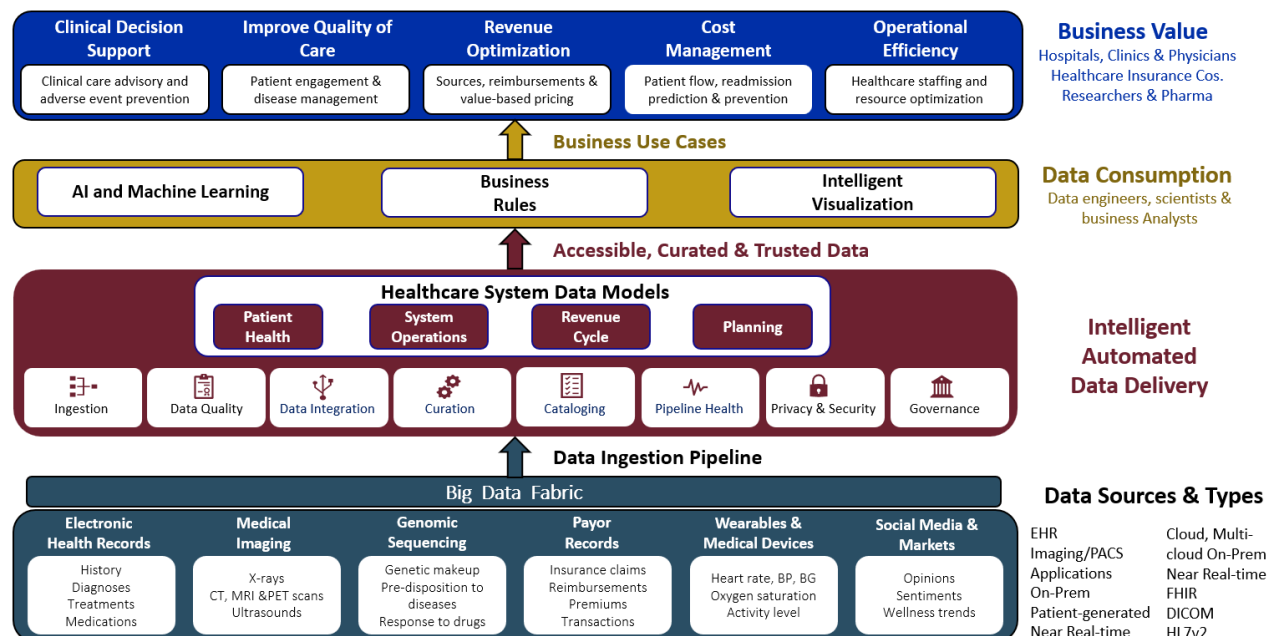
- **A Trusted and Governed Data Pipeline:** This forms the foundation of our system, ensuring the security, privacy, and accessibility of your organization's sensitive healthcare data.
- **Patient and Healthcare Domain-Specific Data Models:** We understand the unique nuances of healthcare data. Our platform utilizes pre-built models tailored to industry best practices, allowing for seamless integration and analysis of your specific information.
- **Interactive Patient Care and Workflow Dashboards:** Visualizing complex data is crucial for actionable insights. Our intuitive dashboards translate data into clear, concise metrics, empowering informed decision-making across all levels of your organization.

Our Data Analytics Framework unlocks the true potential of your information by removing the barriers of data fragmentation. Our solution is not just a sales pitch; it's an invitation to transform your healthcare operations, empower your teams, and, ultimately, deliver on the promise of exceptional patient care through the power of data-driven insights.

## AN ADVANCED ANALYTICS DATA PLATFORM FOR HEALTHCARE

Our approach involves utilizing proven tools and expertise to enable healthcare organizations with analytics capabilities, resulting in tangible benefits for new and existing use cases. AI has the potential to reshape the industry by improving patient experiences, enhancing efficiency, fostering better health outcomes, and spurring innovation and system growth.

### Healthcare Data Analytics Platform Model



## PATIENT AND HEALTHCARE DATA MODELS

By analyzing patterns and trends in patient data, healthcare providers can make better decisions and provide more effective care. Our healthcare data modeling process organizes patient data to make it easier to analyze, interpret, and use it effectively.

Imagine a massive library filled with healthcare data: patient records, scans, test results, and more, all scattered and unorganized. This is the initial challenge in healthcare data management. The first step involves turning this chaos into order through Healthcare Data Classification Model Management. Consider sorting these "books" into designated sections using labels. These labels, called classification models, can be rules or AI algorithms trained to identify specific diseases, patient demographics, or treatment outcomes.

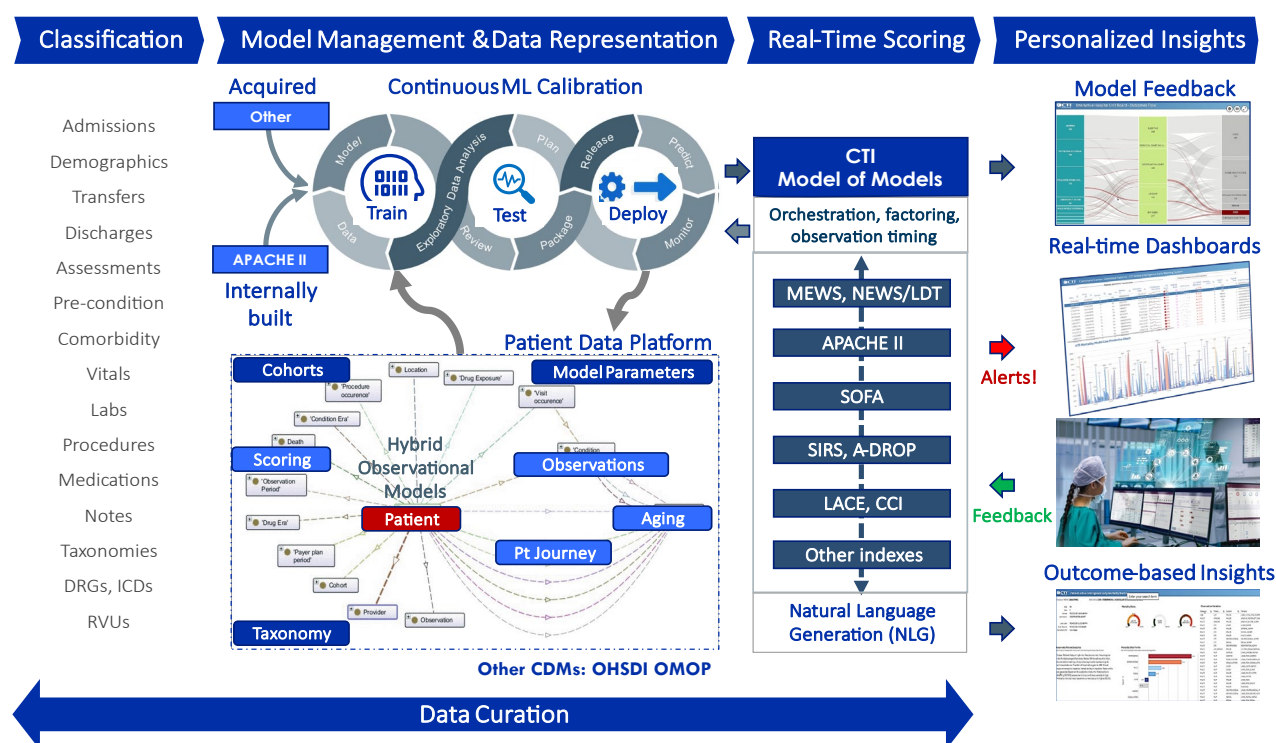
Once categorized, the data needs a common language for analysis. This is where Data Representation comes in. Imagine translating diverse data types like text, images, and numbers into a format computers understand. This could involve numerical grids or symbolic systems, enabling powerful predictive models.

Now, with classified and translated data, we can unlock the power of Real-time Scoring. Consider a dynamic system analyzing new data points, like a patient's test results, and comparing them to trained models. This allows for real-time predictions, such as disease risk assessment or treatment options, displayed on a dashboard for immediate action.

But the power doesn't stop there. By combining real-time scores with individual patient data, we can generate Personalized Insights. Imagine the system tailoring its output to each patient's unique needs. This could involve suggesting specific treatments and preventative measures or even flagging potential risks based on their profile.

Further enhancing this system are Ensemble Models, where multiple prediction models work together for improved accuracy. These models are teams of experts collaborating to provide the most robust insights. Additionally, Generative AI allows the system to create new data points or scenarios based on existing data, unlocking further possibilities beyond basic scoring and classification.

## Healthcare Data Model Management



Accurate and meaningful analysis, reporting, and decision-making in healthcare rely on effective data modeling. This process ensures consistency, quality, organization, structure, and data integration. The components are:

**A Healthcare Data Model** - a schema that logically represents the data elements and their relationships.

**Data Dictionary** - the data elements, their definitions, data types, and permissible values. The data dictionary helps maintain consistency and clarity across different data sources and systems.

**Entity-Relationship Diagrams (ERDs)** - the healthcare system's entities (such as patients, providers, and medications) and their relationships.

**Data Standardization** – a representation of healthcare data using standards like HL7, SNOMED CT, LOINC, and ICD-10 to help improve data consistency and ensure interoperability and consistent data exchange.

Healthcare data can be harnessed from raw data flowing through classification and transformation to real-time scoring and personalized insights, with ensemble models and generative AI pushing the boundaries.

## DYNAMIC HEALTHCARE PROVIDER DASHBOARDS FOR CARE MANAGEMENT

Imagine real-time data streams revealing patient volume, occupancy, trends, and demographics. Leave behind static reports and embrace a data-driven future with next-generation patient census dashboards. Transcend mere data aggregation, seamlessly integrating diverse sources – structured clinical records, unstructured physician notes, and external data feeds – to generate a unified, real-time understanding of your patient population. This heterogeneous data fusion paints a real-time, holistic picture of your patient population.

But the true power lies beyond simple data display. Advanced machine learning algorithms trained on historical data and enriched by real-time streams unlock predictive capabilities, enabling you to forecast future bed needs, anticipate patient flow fluctuations, and identify potential readmissions before they become realities.

Generative AI goes beyond projections, simulating scenarios based on patient characteristics, historical data, and external forecasts. Uncover hidden patterns and potential resource bottlenecks before they arise, informing proactive resource allocation and personalized care planning strategies.

This real-time data fusion empowers you with insightful dashboards that visualize crucial metrics. These dashboards enable granular analysis by ward, specialty, or specific patient demographics. Complex data is translated into actionable intelligence, driving informed decision-making across all levels of your organization.

A patient census dashboard becomes more than just a data repository; it transforms into a strategic command center. By leveraging the power of real-time, trusted data, you can optimize resource allocation, streamline patient flow, and deliver exceptional, proactive care – ensuring you are equipped to meet the evolving needs of your patient population.

## Resource Management

A patient census dashboard is a valuable tool for healthcare payers and providers, offering real-time visibility and insights into their patient population. It presents key metrics and data visualizations related to patients admitted, discharged, and in their care.

Utilize the predictions from the models to optimize resource allocation and manage patient census efficiently. There are many areas where this approach can be helpful:



**Admissions Forecasting:** Build models to predict future patient admissions. This helps estimate the number of patients arriving within a given time frame, allowing hospitals to anticipate resource needs.



**Length of Stay Prediction:** Develop models to estimate the length of stay for admitted patients. This helps with discharge planning, allowing hospitals to optimize patient flow.



**Bed Management:** Based on admission forecasts and length of stay predictions, allocate beds appropriately, ensuring availability for incoming patients and facilitating timely discharges.

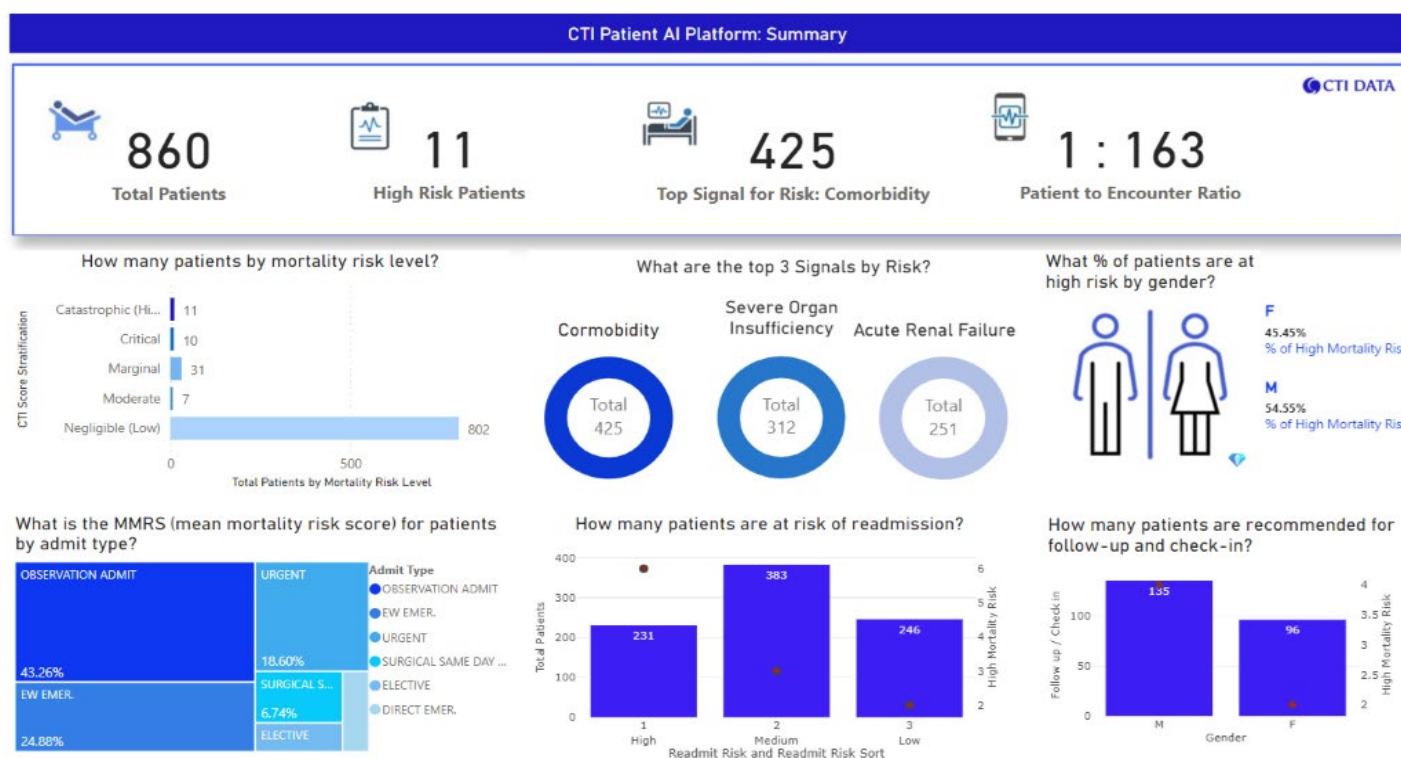


**Staffing Optimization:** Use predictive analytics to align staffing levels with anticipated patient demand, preventing overstaffing or understaffing situations.



**Discharge Planning:** Identify patients likely to have shorter lengths of stay or are ready for discharge, enabling proactive discharge planning and facilitating the timely release of beds.

### Patient Census Dashboard



## Patient Risk Surveillance

Our patient surveillance dashboards based on our model incorporate proven decision-support tools and techniques to monitor and track patient health data. They represent a powerful tool for healthcare providers and public health entities to monitor patient populations and identify potential health risks in real-time.

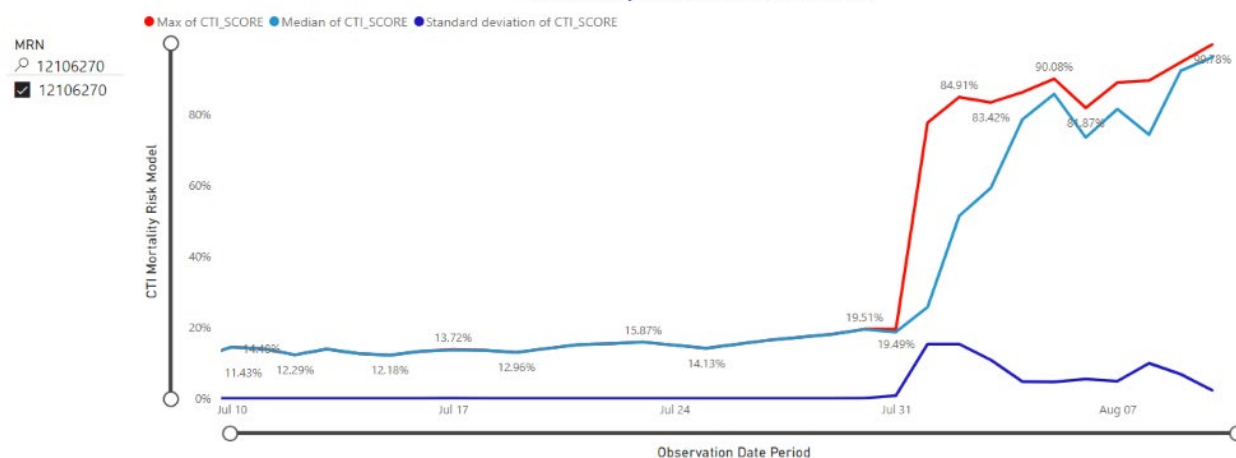
Predictive analytics helps identify abnormal patterns, deviations from normal ranges, and potential health risks to suggest a need for proactive intervention. Tracking adverse events, medication errors, and HAIs can enhance patient safety and improve the quality of care.

An effective data model is crucial for structuring and integrating data from diverse sources for meaningful insights. We combine multiple clinically validated patient assessment tools to create a comprehensive, accurate view of acuity using data from sources including EHRs, administrative systems, other healthcare providers, and social determinants of health.

### Clinical Surveillance Dashboard

MRN	Encounter ID	Gender	Age	Admit To	Admission Date	CTI Score	APACHE Score	LDT NEWS Aged Score	Comorbidity	Readm. Risk	Risk Stratification	Past ER Visits
12106270	29333624	F	65	OBSERVATION ADMIT	7/10/2135	99.78%	17	14.00	0	Medium	Catastrophic (High)	1
18711331	29023380	M	64	URGENT	7/14/2178	99.68%	6	1.00	0	High	Catastrophic (High)	1
16467092	26269762	F	69	OBSERVATION ADMIT	7/12/2137	99.42%	6	7.00	1	Low	Catastrophic (High)	0
18078692	26545545	F	66	URGENT	7/12/2184	97.18%	18	6.00	0	High	Catastrophic (High)	1
12175964	28055342	M	59	OBSERVATION ADMIT	7/4/2126	96.80%	10	2.00	0	High	Catastrophic (High)	0

CTI Mortality Model Live Predictive Chart



The surveillance model can identify potential risks and alert healthcare providers to act promptly. It also offers timely decision-support capabilities by providing insights, recommendations, and treatment guidelines based on the latest assessment data.

Creating a clinical surveillance dashboard requires careful planning and data management, as well as analytics and visualization expertise. However, the potential benefits for patient safety, care quality, and public health surveillance are immense, making it a valuable investment for healthcare organizations.



## Risk Assessment

Combining multiple models and techniques, a healthcare patient surveillance ensemble model (model-of-models) aims to provide a comprehensive and holistic view of patient health, enhance patient safety, and improve healthcare outcomes. It enables healthcare providers to proactively identify and address potential concerns, reducing hospital readmissions, adverse events, and unnecessary healthcare costs. This solution framework consists of:



**Descriptive Analytics:** Calculate basic statistics and generate summary reports to understand the characteristics of the patient population and mortality rates.



**Predictive Analytics:** Build predictive models using machine learning algorithms to predict the risk of mortality based on the selected features.



**Survival Analysis:** Analyze time-to-event data, such as the projected mortality without intervention; survival analysis methods like Kaplan-Meier curves or Cox proportional hazards models can be used.



**Risk Stratification:** Segment the patient population into risk categories based on the developed models or statistical analyses. This helps identify high-risk groups that require additional attention or interventions.

Combining multiple commonly accepted assessment models, we leverage their strengths to improve surveillance capabilities.

The healthcare industry produces and relies upon massive amounts of data from diverse sources. That creates a rich environment for applying AI and ML. Given the inefficiencies inherent to the complexities of the healthcare system, there is an evolving need to look for new ways to leverage these technologies constantly. Our goal is to enhance the accuracy of patient monitoring, early detection of deteriorating health conditions, identification of at-risk populations, and the precision of predicted outcomes.

## CLINICAL WORKFLOW MANAGEMENT: TRUSTWORTHY DATA AND THE POTENTIAL OF GENERATIVE AI

Optimizing clinical workflows for quality care and achieving Clinical Quality Measure (CQM) goals remains a constant challenge for Chief Data Officers. The role of trusted, governed, real-time data from any source is critical for Clinical Workflow Management (CWM) and essential with the emerging potential of Large Language Models (LLM) in assisting these workflows.

Generative AI stands poised to revolutionize hospital workflows. Transformative power comes from trusted data when it's unlocked to increase speed-to-insights, enhanced collaboration, continuous improvement, and the emerging potential from integration with LLMs and Generative AI. Integrating generative AI seamlessly into hospital workflows requires careful planning and infrastructure development. Robust data governance and security protocols are crucial to ensure patient privacy and data integrity.

## The Paradigm Shift

Traditional CWM, often reliant on historical data, leads to reactive decision-making. However, the integration of real-time data from diverse sources and the potential of LLMs usher in a new era of proactive, data-driven, and potentially augmented healthcare.

### *Unlocking the Potential of Clinical Workflow Management*

Feature	Traditional CWM	Real-time Data with LLMs
EHR Alerts	Static prompts	Predictive tools using real-time data, external factors, and LLM-refined insights for optimal interventions.
Collaboration	Disparate data silos	Seamless access to complete patient history facilitated communication and shared understanding through LLM-processed medical narratives.
Continuous Improvement	Static CQM targets	Dynamic feedback loops are fueled by real-time data, with LLMs analyzing trends, identifying correlations, and suggesting evidence-based improvements.
Data Governance	Rigid rules	Flexible framework with LLM-assisted anonymization and de-identification for privacy and compliance.
Patient Empowerment	Limited access to information	Secure access to health data, personalized reminders, and participation in remote monitoring are provided by LLMs, which provide clear and concise summaries of complex information.

## The Importance of Trusted Governed Data

While the speed of access to timely information is valuable, unlocking the true potential of real-time data and LLMs hinges on **trust**. Robust data governance, access control, and security measures are paramount. Your CWM platform must prioritize data privacy and compliance. Additionally, the success of LLMs relies heavily on **data relevancy, privacy, and quality**. Biased or inaccurate data can lead to flawed predictions and harmful outcomes. Therefore, rigorous data quality checks and responsible data collection practices are essential.

CWM powered by trusted, governed, real-time data, and the emerging potential of LLMs is not just a technological advancement; it's a cultural shift. It empowers proactive care, fosters collaboration, drives continuous improvement, and facilitates personalized patient care. By investing in this transformative approach, CDOs can unlock the full potential of data-driven healthcare, ultimately leading to better patient outcomes and a more efficient system.

Real-time trusted data is the foundation and the fuel, and LLMs can be the engine for a healthier future.

## HEALTHCARE AT A CROSSROAD - EMBRACING TECHNOLOGY TO THRIVE

The healthcare landscape is in a state of dynamic transformation. Technological advancements, groundbreaking discoveries, evolving regulations, and a changing patient population are converging, creating challenges and immense opportunities. Healthcare leaders must become technology champions to navigate this dynamic terrain, leveraging advanced analytics and predictive models to propel their organizations forward.

### *Boundless Transformative Opportunities*



## Unlocking New Frontiers

The synergy of technology and healthcare is unlocking exciting possibilities. Beyond the initial excitement of predicting outbreaks and personalizing treatment lies a deeper, transformative power unlocked by advanced data and analytics in healthcare. It's not just about anticipating disease or streamlining processes but fundamentally restructuring the healthcare ecosystem to prioritize precision, prevention, and proactive care.

Consider the value driven by using advanced data and analytics in these ways:

- **Predictive analytics:** Forecasting disease outbreaks, tailoring preventative measures, and identifying high-risk patients for early intervention.
- **Prescriptive models:** Optimizing resource allocation, streamlining patient journeys, and personalizing treatment plans for improved outcomes.
- **AI-powered diagnostics:** AI analyzes medical images with unparalleled accuracy, accelerating diagnoses, leading to faster treatment and better patient experiences.

This deeper dive into the potential of data and analytics unveils a healthcare system that moves beyond reacting to illness and embraces a proactive approach to individual and community well-being. Prepare to delve into the intricacies of this data-driven transformation and uncover the profound impact it's poised to have on the future of healthcare.

## Keeping Pace with Change

Recognizing this fluidity is crucial for providers, as it underscores the need for agility and adaptability to stay ahead of the curve. In other words, simply "going with the flow" isn't enough. Providers must be able to quickly adjust their strategies, processes, and offerings to align with emerging trends and respond effectively to new challenges.

This adaptability manifests in various ways, from embracing innovative technologies to offering flexible care models, all with the ultimate goal of meeting the evolving needs of patients and the healthcare system. By embracing this agile mindset, providers can thrive in the dynamic healthcare landscape, ensuring their continued success and positive impact on patients' lives.

This demands:

- **Real-time insights:** Harnessing the power of data analytics to gain instant insights into patient needs, resource utilization, and emerging trends.
- **Data-driven decision-making:** Utilizing data to optimize operations, identify cost-saving opportunities, and make informed strategic decisions.
- **A culture of continuous learning:** Cultivating a workforce comfortable with embracing new technologies and adapting to changing environments.

## Turning Complexity into Advantage

Healthcare is inherently complex, with unpredictable patient demand and resource-intensive operations. This is where AI and Machine Learning come in:

- **Balancing supply and demand:** AI can predict patient surges and optimize staffing levels, ensuring efficient resource allocation and reducing wait times.
- **Personalized care:** ML algorithms can analyze vast datasets to tailor care plans to individual patients, improving outcomes and reducing costs.
- **Automating repetitive tasks:** AI can automate administrative tasks, freeing healthcare professionals to focus on what they do best – providing compassionate care.

The call to action is clear. Healthcare leaders must embrace technology as a strategic partner. By harnessing the power of advanced analytics, AI, and ML, they can unlock new frontiers of care, navigate the dynamic landscape, and ensure their organizations thrive in the ever-evolving healthcare ecosystem.

By collaborating with our team of data and analytics experts and leveraging our advanced data and analytics framework, you can implement meaningful changes and achieve measurable enhancements throughout your organization.

We work closely with you to develop and share accountability for mutual goals. Then, after deployment, we follow through to ensure we've met our shared objectives and that you are satisfied with the solutions we've delivered for your organization.

[Contact us](#) to explore our real-world case studies and learn more about how we help our healthcare payer and provider clients grow and create business value.