White Paper

Unified Analytics

Disrupting traditional healthcare delivery and driving the future of health

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Introduction

Over the years, rising costs, ageing population and chronic diseases have kept the governments and regulators unsettled. By 2030, global healthcare spending is expected to reach an unprecedented USD 18.3 trillion.

In the Middle Eastern region, Saudi Arabia alone has witnessed an increase of around 1.9% each year in the per capita health spending. The life expectancy in the region increased by 1.216 years from 73.917 to 75.133 years between 2010 to 2019 but this also meant rising number of chronic disease and comorbidities[1]. In Saudi Arabia, there has been a constant increase in the prevalence rates of chronic diseases. In 2016, it was noted that they formed up about 60% of all premature deaths and this number was estimated to increase up to 73% by 2020. Of these, the highest prevalence rates of 23% and 26% were that of diabetes and hypertension respectively[2]. Numerous emerging developments are disrupting and improving traditional health care delivery and business processes majorly driven by more widespread use of health analytics. This is enabling tremendous insight into not only disease conditions, progression, and the various impacts of care modalities, but also insights into which points-of-care and care providers hold greatest influence and relationship with the patient.

THE TECHNOLOGICAL IMPACT OF COVID-19 ON THE HEALTHCARE ECOSYSTEM

Before the COVID-19 pandemic, the adoption of advanced analytics was steadily increasing in the healthcare industry. But the onset of the pandemic has sharpened the focus on it even more. The pandemic has brought some unique and previously unforeseen challenges to the healthcare industry, compelling a change in the way healthcare organizations have traditionally handled healthcare data. During the initial stage of the pandemic, the governments and healthcare organizations across the world quickly realized some hefty clinical as well as operational hurdles. For example, a study conducted using a susceptible-exposed-infectious-removed (SEIR) model to estimate COVID-19 epidemiological parameters before the implementation of preventive measures in Wuhan, China revealed that if the measures had been started 1, 2, or 3 weeks earlier, the cases could had been reduced by 66%, 86%, and 95%, respectively. These findings highlight the challenges of surveillance in controlling COVID-19[3].

The COVID-19 pandemic has brought about some unique and previously unforeseen challenges to the healthcare industry, compelling a change in the way we traditionally handle healthcare data

Near real-time population health surveillance

Effective disease prediction and monitoring

Healthcare resource decentralization due to risk posed by centralization during pandemics

Deeper insights into drivers and risk factors of diseases

Granular and timely data for predicting demand and supply

Virtual trials to minimize disruption to research

The integral role of data for health systems

Although the health data volume has grown exponentially in the recent years, the access and availability problems have exacerbated within the healthcare industry owning to myriad disparate systems as well as reporting and analytical tools. The urgency of the pandemic has pushed the healthcare industry to adopt data and analytics more rapidly for decision making, and it is expected that the new normal will move away from siloed systems to a more secure, federated, and interoperable ecosystem integrating heterogenous data sources enabling analysis of high velocity of health data in real-time. With a significant magnitude and depth of unutilized healthcare data that exists today, the promise of health analytics is considerable.

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The initial results of the use of analytics in healthcare have been promising. A hospital group in the US reportedly saved USD 120M in annual costs (about USD 12,000 per patient) and boosted facility utilization by 5% using big data analytics[4].

Similarly, another hospital group in the US reduced 6,000 occurrences of patient readmission, avoided USD 4M in potential Medicare penalties, and saved about USD 72M annually in medical service costs [4]. Furthermore, it has been observed that the use of big data analytics has improved patient outcomes, as noted by Penn Medicine, who created a predictive model which could identify about 85% of sepsis cases (up from 50%) 30 hours before the onset of septic shock (as opposed to 2 hours using traditional methods)[4].

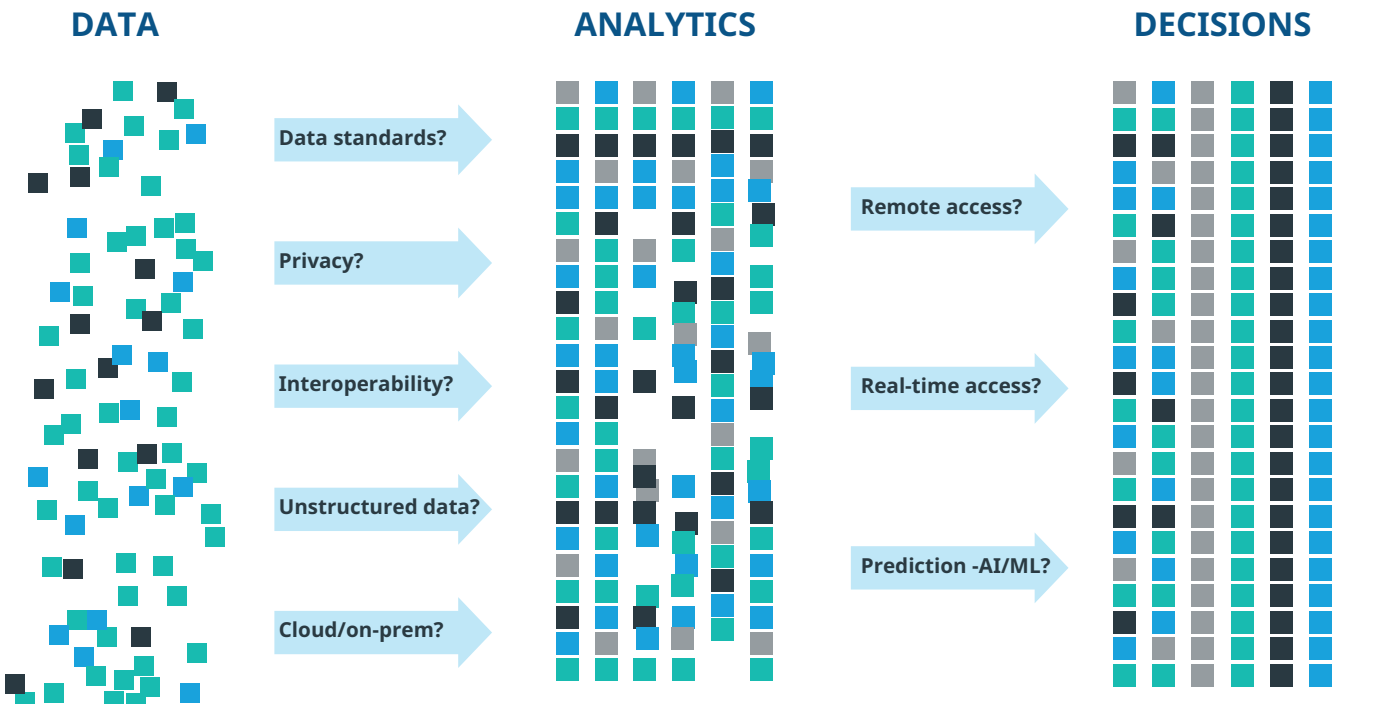
Why a unified approach to health data analytics is the need of the hour?

Emerging infectious diseases are a constant threat to public health worldwide. In the past decade, several major outbreaks, such as the 2009 influenza pandemic, the Middle East Respiratory Syndrome coronavirus (MERS-CoV), the emergence of Zika and the West African Ebola virus disease (EVD) outbreak, have been potent reminders of the need for robust surveillance systems and timely responses to nascent epidemics. These outbreaks highlighted the difficulties of maintaining situational awareness in the absence of standards for surveillance, data collection and analysis, as well as the challenges of mounting and sustaining a large-scale international response.
Hence, an important feature of the modern response to epidemics should be to increase focus on exploiting all available data to inform the response in real time and allow evidence-based decision making.

It's not the scarcity of data that is the issue, but the parallel systems have compartmentalized these information systems so much so that there has been an increase in vertical information capacity – without any coordination and integration of effort across the systems. Governments and organizations across the globe have largely employed technologies that are highly fragmented to store and process health data. The health data is scattered across non-communicating systems, each having their own vernacular, programming language, syntaxes, and practices. Moreover, not all the data is the same. There's big data, thick data, and structured, unstructured, and multi-structured data. Some systems can only process certain types of data, and servers deployed on-premise may not be able to communicate with cloud-hosted tools.

Governments and healthcare organizations need to gear up for a big shift in their operational models for applying advanced analytics. They should align their broader technology strategy to adopt a comprehensive approach to unify and analyze health data from various siloed systems and sources. It is expected that only the organizations who will develop capabilities to efficiently unify the health data at scale to generate actionable insights with the use of technology, will succeed in overcoming the broader healthcare delivery and management challenges. Without a unified way of managing data, organizations will not be able to make informed decisions based on holistic evaluation of scenarios. Once the data silos are eliminated, the platform needs to analyze and understand this data in real time to provide actionable insights. This will not only enable them to build strong and relevant data pipelines from diverse systems and prepare labeled datasets for model building, but also perform AI/ML driven advanced analytics models iteratively on massive interoperable data sets.

Current state of play in fragmented healthcare systems



What drives the unified analytics approach?

Developing the innovation mindset is an important step towards encouraging the adoption of health analytics and overcoming any reluctance to move from closed to flexible innovation models. Organizations looking to adopt the unified analytics approach need to first understand its core building blocks, which can be broadly grouped into the following:

Interoperability of heterogeneous data sources – Integrating clinical as well as non-clinical datasets such as travel data, citizen generated data and social media data into an interoperable healthcare ecosystem, so that data can be shared and used across various healthcare systems. Governments all over the world are trying to leverage and develop analytical capabilities that could integrate data from multiple sources to provide actionable insights. Since the COVID-19 outbreak, there has been a raising trend globally, of increasing investments in healthcare data lakes and big data analytics systems in healthcare as an aggressive measure to combat the spread of the coronavirus. A hospital group in the US reported a 40% decrease in the number of patients holding in the emergency department waiting for a bed, a 62% increase in direct admission conversions and an increase in its patient acceptance rates for transfers from 68% to 78% after the application of a healthcare command center allowing for cross-collaboration and enterprise-wide visibility5.

Real-time analysis of high velocity data – Real-time data driven decision making enables generation of critical and actionable insights such as predicting sites of possible infection and flow of a disease. It can also help in estimating the need of beds, healthcare specialists, and medical resources during a crisis like COVID-19. For example, by leveraging the real time command center, the critical care transport team in a hospital group in the US was able to reduce transfer delays from the operating room by 70%, and patients in the ED were assigned to beds 30% faster[6].

Anonymized and federated access to data – Sharing of health data, albeit in a secure and controlled manner will enable different organizations to collaborate and work towards fulfilling shared goals of reducing infections, developing treatments and vaccines. The risks and costs of healthcare data breaches are enormous, and it opens millions of citizens to the risk of leakage of confidential health information. This establishes the need for data security in health care and emphasizes that it is a challenge that necessitates both innovation and communication. As regulatory standards for healthcare data privacy such as HIPAA and GDPR become more stringent, healthcare organizations are keen on implementing best practices that ensure continued compliance and lower risks.

A unified analytics ecosystem

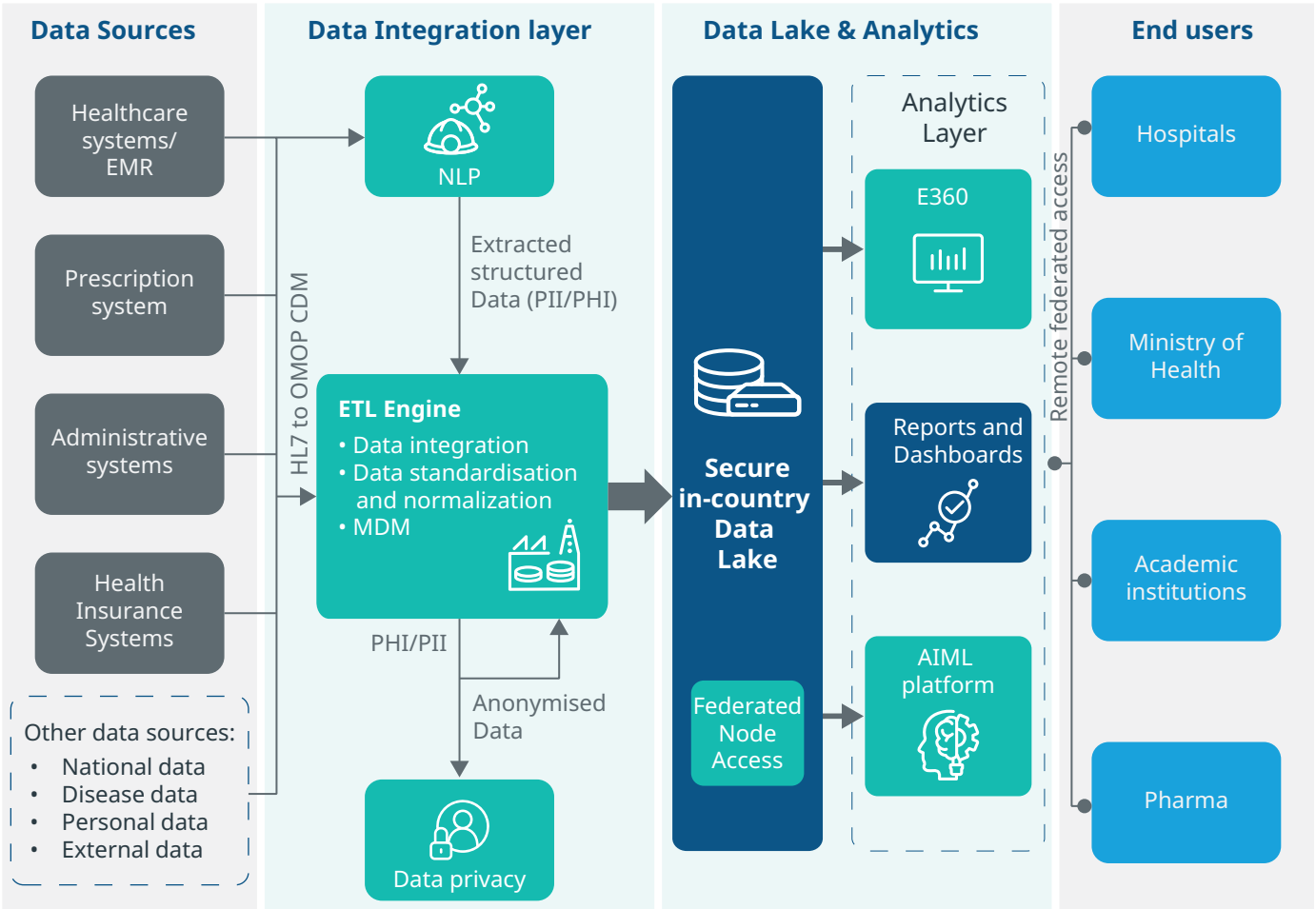
A unified analytics ecosystem for the analysis of health data essentially works on the principle of acquiring, consolidating, and processing variety of data assets from multiple heterogenous data providers to facilitate a holistic analysis of the population's health. The heterogenous data network is connected via adapters and network services to orchestrate secure and federated data access. This data is then ingested into a centralized data factory where multiple operations are performed on it to convert it into a standardized structure across the data sets. This can include standardization of data flow with a common data model, text mining to transform free text from clinical notes, claims, etc. into a normalized, structured data suitable for analysis and risk-based deidentification and anonymization compliant with global standards. These rich streams of information can be further analyzed to enhance the patient experience, optimize resource management, care, and low-cost treatments.

At an individual level, health analytics can help providers deliver the right care to the right patient at the right time. On a larger scale, it can enable health systems to identify and understand larger trends, leading to improved population health strategies. For example, analyzing a holistic view of a population health data over several years can provide tremendous insight into not only disease conditions, progression, and the various impacts of care modalities, but can also enable insights into which points-of-care and care providers hold greatest influence and relationship with the patient.

New technologies for healthcare analytics

Today, health systems and providers are exploring different ways to use big data platforms and AI for predictive analytics and the future of health will likely be driven by digital transformation enabled by radically interoperable data and open, secure platforms. Streams of health data—together with data from a variety of other relevant sources—will merge to create a multifaceted and highly personalized picture of every

A Unified Analytics Platform acquires, consolidates and processes variety of data assets from multiple heterogenous data providers facilitating a holistic analysis of population's health



consumer's well-being. These solutions will enable health organizations transition from simply using data to learn what already happened to using that data to reliably forecast what could happen in the future.

The growth in health data assets and progressive advancement in technology such as electronic health records and virtual assistants is streamlining medical processes and improving both patient outcomes and safety.

Recent research suggests that Machine learning can help in reduction of the misdiagnosis of malignant tumors by up to 85%. Systematic use of AI/ML based algorithms can significantly reduce fraud in medical insurance and payment schemes that cost the industry $80 billion annually[7].

Emerging AI/ML based strategies are helping to redefine healthcare industry's information processing capabilities more than ever. Natural language processing (NLP) is a rapidly developing area of machine learning that can identify key syntactic structures in free text, help in speech recognition and extract the meaning behind a narrative. NLP tools can help generate insights from documents, like a clinical visit summary, or to dictate clinical notes. The unique content and complexity of clinical documentation can be challenging for many NLP developers. Nonetheless, we should be able to extract relevant information from healthcare data using such approaches as NLP. The application of AI/ML and natural language processing (NLP) can bring a tremendous amount of value across the current healthcare continuum to the delivery of improved outcomes. Recent research suggests that Machine learning can help in reduction of the misdiagnosis of malignant tumors by up to 85%. Systematic use of AI/ML based algorithms can significantly reduce fraud in medical insurance and payment schemes that cost the industry $80 billion annually[7].

The next breakthrough in healthcare may not be a one-size-fits-all solution. Novel approaches to treatment and prevention of diseases, such as Precision Medicine, points to a new generation of personalized medicine to treat and perhaps cure some of the world's most infamous diseases. Using a patient's full medical profile—from genetic data, medical history, environmental factors, and even lifestyle—precision medicine aims to create a customized and unique treatment and prevention protocol for every patient. Similarly, the dynamic world of voice technology is impacting healthcare through several use cases. With the evolution of speech recognition, patients can be able to navigate the user interfaces of remote monitoring devices and personal health devices.

The use of such new technologies in healthcare will also help support new models of "value-based care" and with the increase of Big Data – it can be leveraged to drive more personalization and transformation in healthcare to patients. According to a recent study, organizations that have adopted a unified data analytics approach experience revenue acceleration, improved productivity and infrastructure savings, resulting in up to 417% ROI on their data analytics and AI projects[8].

THE POTENTIAL OF AIML IN TRANSFORMING HEALTHCARE

The enormous potential of health analytics includes helping identify patients at risk for chronic conditions, developing evidence-based best practices, and proactively spotting potential obstacles to care plan adherence. Data can help clinicians remain one step ahead of events, delivering proactive care to patients before their health becomes critical.

Many organizations are already beginning to incorporate systems that can generate, gather, and share data from variety of clinical and non-clinical systems. For example, in the UK University

Hospitals of Morecambe Bay Trust (UHMBT)'s Royal Lancaster Infirmary site uses real-time analytics to get information viewed on large, interactive screens on the number of ambulances on the way and availability of beds. This has helped them to assess their resources and streamline according to needs, increasing the number of patients triaged within 15 minutes by 30 percent (from 65% to 95%)[9]. Similarly, Massachusetts Institute of Technology (MIT) carried out a study on application of big data analytics in intensive care units reported that health analytics can positively predict critical information, such as length of hospital stay, number of patients requiring surgical intervention, and which patients could be at risk for sepsis or iatrogenic diseases[10]. Another study proposed a modeling of health risk assessment using a deep neural network, as a way of BDA, based on medical big data, concluding that the model can have a quite positive impact on human quality of life[11]. Advanced cognitive technologies are being developed to analyze a significantly large set of parameters and create personalized insights into a consumer's health.

Reduced time and cost for drug discovery

Through the analysis of large amounts of data and the use of "machine-vision" image analytics, AI is promising to help reduce the time and cost in drug discovery by identifying candidate molecules.

Reduced administrative expenses

AI/ML can be used for probabilistic matching of data across different databases. For example, reliably identifying, analyzing and correcting coding issues and incorrect claims saves all stakeholders a great deal of time, money and effort.

New ways to deliver care

Organizations are likely to deem the use of technologies leading to a higher percentage of health care related activities to become automated, allowing stakeholders to focus more of their time on skills sets and top-of- license activities that create greater value add

Tools for more effective diagnosis and treatment

AI will likely create additional capabilities in diagnosis and treatment, fueled by advancement in systems such as imaging systems that will potentially become the primary interpreters of imaging studies and radiologist only reviewing imaging studies that exceed a certain level of uncertainty of the AI system.

A better patient journey

The real health care benefit will likely be the synergies obtained through combining the power of AI-related technologies across the entire patient journey

More informed and effective treatment plan design & delivery

AI/ML systems can create treatment plans in minutes or even seconds, as compared to the hours it might take a human. Respondents in prostate cancer clinical trials comparing ML-generated treatment plans with those created by expert human planners ranked the ML plans as equivalent.

Conclusion

The pandemic is a turning point that will shape the way we live. From the healthcare perspective, there is an urgent need to focus on rebooting the healthcare systems. Governments and organizations globally will need to invest more towards a resilient and robust healthcare system that is equipped to cope with any disaster of this magnitude in the future. Strengthening public health systems through enhancing the capacity of public health personnel to fill in the gap, both in terms of quantity and quality, is vital. Further, sophisticated solutions like Artificial Intelligence will be increasingly applied in health sciences. But importantly, monitoring/surveillance for diseases will require new solutions and innovations with the ability to prepare surveillance systems to be made more timely, flexible, and sensitive, without compromising on quality.

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