HEALTHCARE ANALYTICS

A REPORT BY ATOMCAMP

atomcamp

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About Us

atomcamp is a continuous learning platform that is helping the youth and organizations unlock opportunities with Data Science.

Our mission is to promote a culture of continuous digital learning; digital skill development for the youth; interdisciplinary learning; and build strong learning communities.

Technology Bootcamp

At atomcamp, we offer a variety of multidisciplinary courses, but our main focus is Data Science, and Artificial Intelligence which are relatively new and emerging fields, especially in Pakistan. Our goal is to make careers in these fields accessible to everyone in Pakistan - regardless of the educational or professional background.

atomcamp's 6-month Data Science Bootcamp enables participants to learn relevant data skills and launch their careers. The program is meant for those who are aiming to switch into a data science career as well as those who want to incorporate data science training into their current jobs/careers to remain competitive.

Data Science Bootcamp is offered every 2 months- all online, with excusive mentorship and career guidance, customized trainings for individuals, corporate firms and organizations. We offer complete flexibility in learning, and course design.

About the Author

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Our Mission

promote a culture of continuous learning

provide skill development for youth

encourage interdisciplinary learning

build learning communities

provide contextual & accessible knowledge

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Understanding Healthcare Analytics

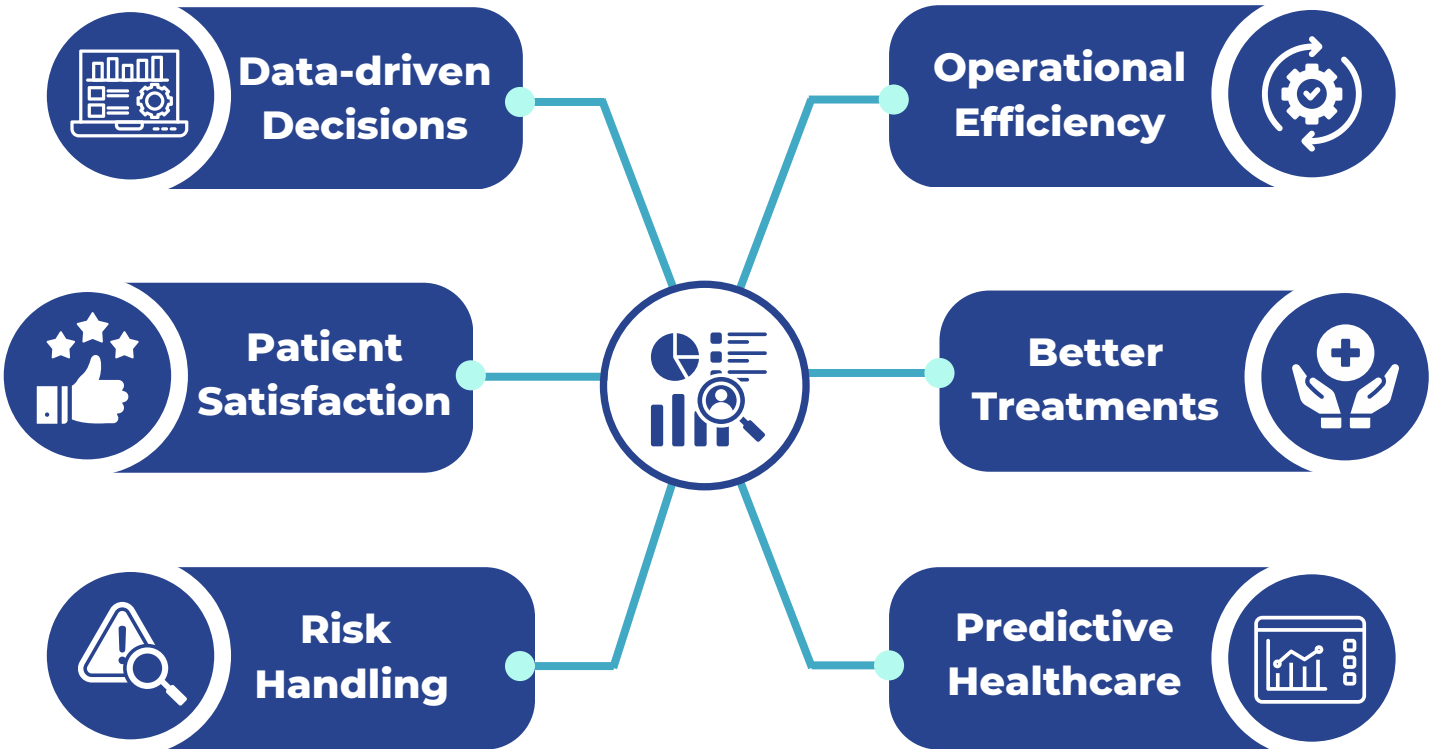
Healthcare analytics is the use of data collected on a large scale that provides stakeholders with actionable insights. It combines real-time and historical data to predict trends, reveal actionable insights, achieve medical advances, and drive long-term growth. These insights can be used by healthcare providers, hospital and health system leaders, those in government health and human services, and independent researchers to make evidence-based decision making and deliver value for the people they serve[1]. With the latest technology to collect and store data, health analytics is also making its way to the mainstream health industry. The global healthcare analytics market in terms of revenue was estimated to be worth $27.4 billion in 2022.

Importance of Healthcare Analytics

Healthcare analytics have emerged to play a significant role today. According to the British Media Journal (BMJ), 40,000 to 80,000 deaths per year occur due to misdiagnosis[2]. This reflects that clinical data has not been given much importance due to lack of use of data analytics tools. The demand of medical staff to uphold care standards, along with budget constraints means that the lack of use of data in medical settings still persists. Therefore, healthcare analytics have become important for the following reasons:

40,000 to 80,000

deaths per year occur due to misdiagnosis



How is Health Analytics Transforming Healthcare?

In today's world, health analytics have become a central part of health analysis in various forms. The use cases of healthcare analytics range from providing in-depth insight into a patient's treatment to enhancing data security of an organization[3]. Following are three areas where healthcare analysis plays a significant role in the health industry.

01

Analyzing Clinical Data

Electronic medical records are used for tracking patients' health and keeping their records in digital format. The primary purpose of these records is to analyze a patient's clinical data for medical images, test results, diagnosis and treatment.

02

Gaining Operational Insights

It is the assessment of current conditions of a healthcare institution that is aligned with the institution's strategies for improvement. This is useful in achieving the operational efficiency for example cost-effective use of health technology.

03

Improved Staffing

Health analytics helps in recruiting, training, and retaining healthcare workers. This is important as healthcare providers need to maintain a balance between costs and employ qualified professionals. According to a study, labor costs about 60% of the hospital budget[4].

Fields of Healthcare Analytics

Healthcare analytics have emerged to become a significant field in the 21st century. With increasing population, health concerns of people have also heightened. From studying patterns in health of the people to achieving cost efficiency in healthcare institutions, healthcare analytics has become a pivotal part of day to day healthcare functioning. Following are some of the prominent fields in healthcare analytics today.

I. Clinical Analytics

Clinical Analytics as a field makes use of medical data to increase revenue and save costs, and generate insights to make informed decisions. The implementation of clinical data analytics in health institutions has led to improved population health and reduced medication errors[5]. The rapid adoption of this field is due to the emergence of key

technologies like Electronic Health Records (EHRs). Employing clinical analytics can help reduce administrative costs, enhance care coordination, improve patient wellness, provide clinical decision support, and minimize abuse and fraud. It could also help lower costs by removing differences in supplies, overheads, and labor. Following are some of the real-life applications of clinical analytics around the world.

The Health and Clinical Analytics team at University of Sydney, has collaborated with the Sydney Children's Hospitals Network establishing a network of professionals for healthcare delivery through analytics[6].

The University of Waterloo in partnership with the University Health Network is developing the Clinical Analytics for Real-World Evidence (CARE) Platform to produce data-driven insights[7].

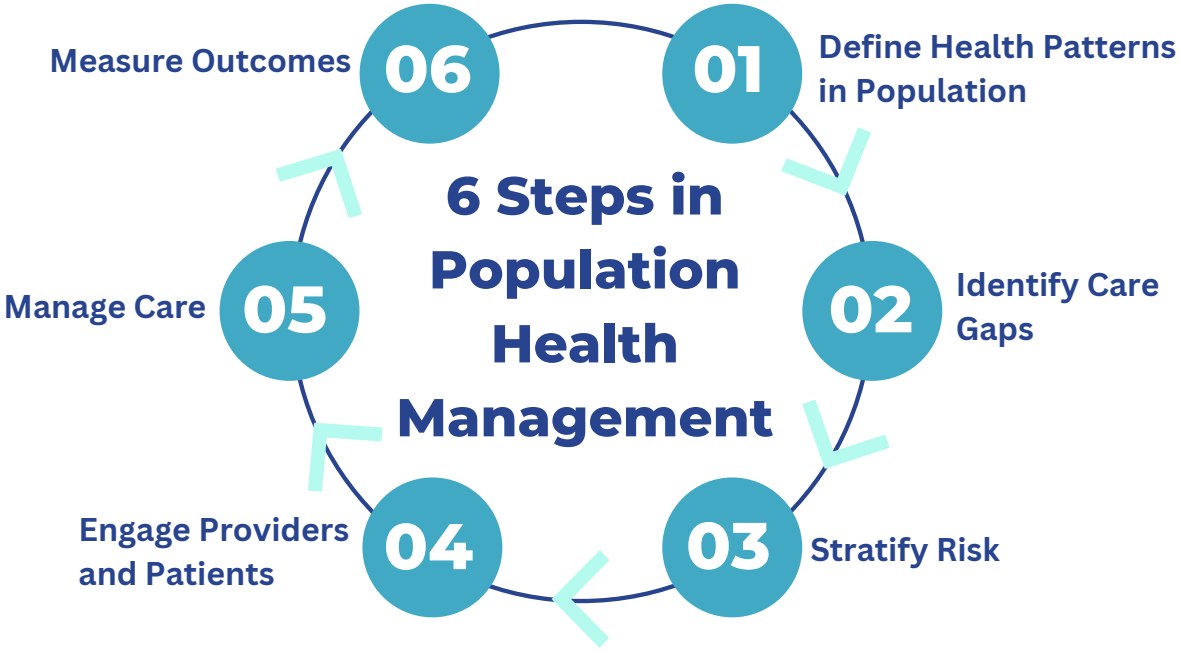
AnMed, a nonprofit health system will leverage XSOLIS' Artificial intelligence (AI) and machine learning (ML) tools through the CORTEX platform by using real-time predictive analytics[8].

Morris Heights Health Center (MHHC) has partnered with Garage, health management company, that will provide its platform, Bridge, to help MHHC to improve care for 50,000 patients in the Bronx community[9].

II. Population Health Analytics

Population healthcare is defined as healthcare efforts that use resources effectively to improve the wellbeing of the population. Population health activities include the promotion of health as well as preventing, managing, and reversing disease progression[10]. For this reason, population health analytics provides critical information to support population health planning. This is achieved by evaluating individual healthcare journeys to deliver health care for the public[11]. The Population Health Market Size is expected to grow to USD 278.8 billion by 2030 at 19.20% Compound Annual Growth Rate (CAGR). According to Clinigence, a healthcare platform, there are 6 steps to population health management[12]:

> **"The population health management market is expected to grow to USD 278.8 billion by 2030 at 19.20% CAGR."**



III. Medical Imaging Analytics

Medical imaging analysis extracts the information about organs and internal functioning of the body. AI-based imaging analytics read images produced with the use of an X-ray, MRI, CT scanning, PET scanning, and ultrasounds[13]. Machine learning and deep learning techniques are extensively used for carrying out the required analytics. The medical image processing is based on extracting features from the images and detecting patterns. It identifies the tumors, diabetic retinopathy, artery stenosis etc. This improves the accuracy of diagnosis for clinical professionals.

Artificial Intelligence (AI)-based imaging analytics are a promising healthcare innovation today. It includes but is not limited to neurology, cardiology, radiology, pathology, orthopedics, dentistry, and oncology.

Top 5 Use Cases for Artificial Intelligence in Medical Imaging

The American College of Radiology Data Science Institute (ACR DSI) released a number of high-value use cases for artificial intelligence in medical imaging, that are listed as follows[14]:

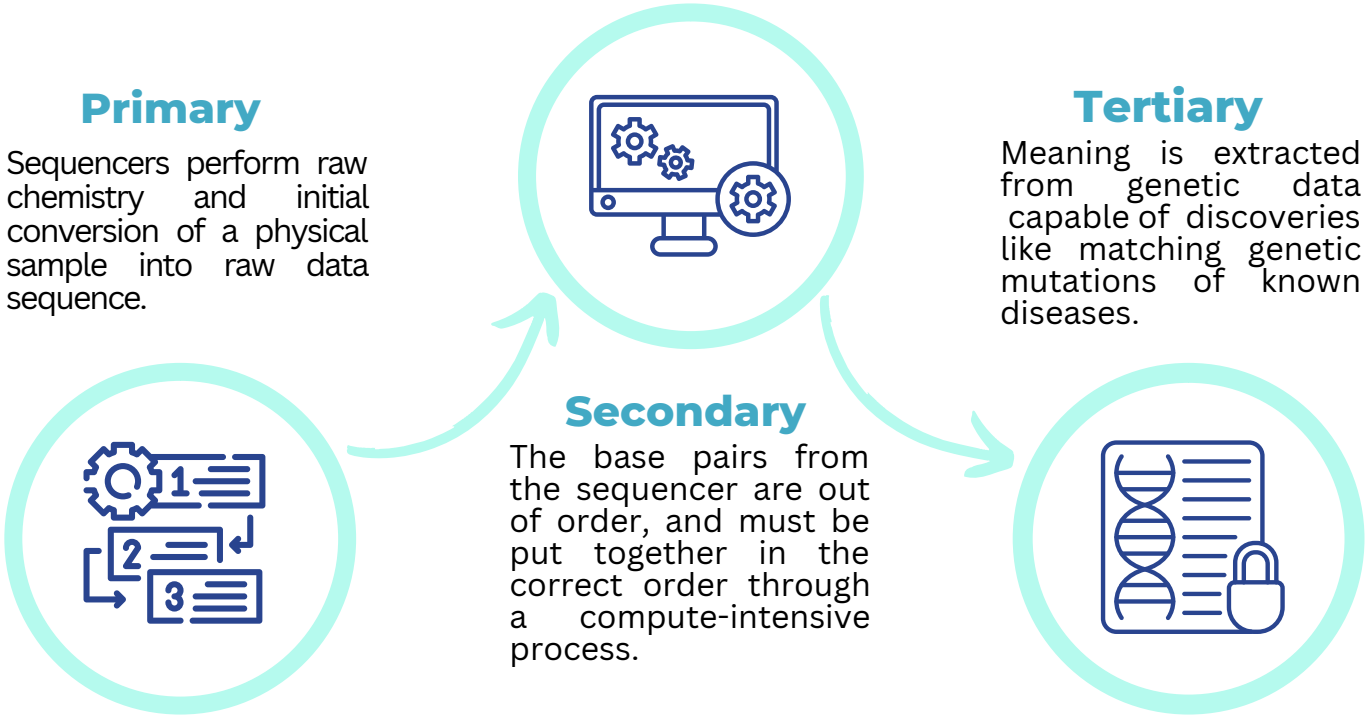
1. Identifying Cardiovascular Abnormalities
2. Detecting Fractures
3. Aiding in the Diagnosis Neurological Diseases
4. Flagging Thoracic Complications and Conditions
5. Screening for Cancer

IV. Genome Analytics

Genomics is the studying and mapping of gene sequences. Data analysis of genomics allows doctors to find life-threatening diseases long before they become a threat; farmers to engineer and produce better crops; and nutritionists to tailor diets according to an individual's needs. Genomic data science enables researchers to use powerful computational and statistical methods to decode the functional information hidden in DNA sequence[15].

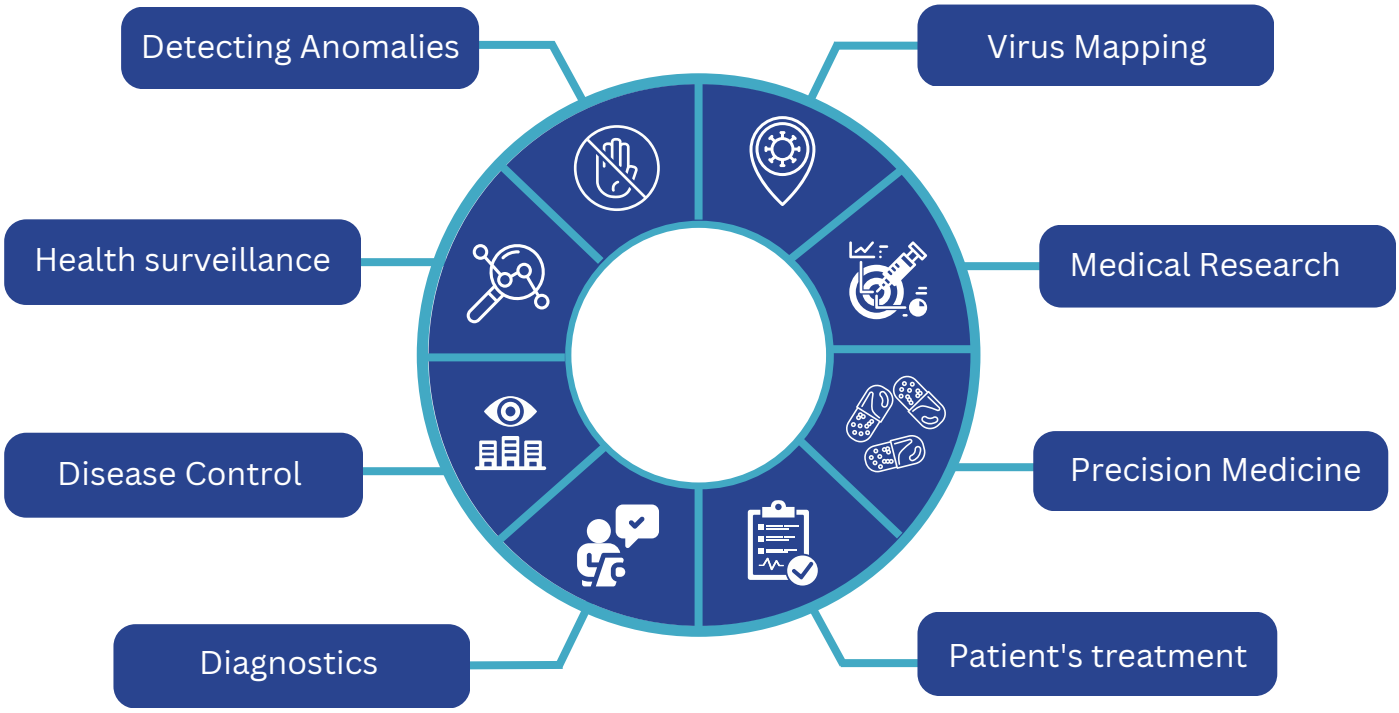
But why do we need data analysis in genomics? Researchers are now generating more genomic data than ever before to understand how the genome functions and affects human health and disease. Data about a single human genome sequence alone would take up 200 gigabytes. We will need an estimated 40 exabytes to store the genome- sequence data of the population generated worldwide by 2025[16]. In comparison, five exabytes could store all of the words ever spoken by human beings. Thus, with such a huge amount of data, genomic analysis becomes significant to understand human health and disease.

Genomics analytics takes place in three stages:



Application of Healthcare Analytics

According to a McKinsey analysis report, healthcare expenses of the USA are $4 trillion making it 16% of its Gross Domestic Product (GDP) in 2021[17]. Comparatively, the healthcare industry was less than 10% of GDP in the previous decade. With such an increase in demand and cost of healthcare, the applications of healthcare analytics also widened. Following are the latest applications of healthcare analytics:



Use Cases of Health Analytics

COVID-19

The enormous amount of data the pandemic generated had enabled researchers and providers to analyze trends, and monitor epidemiological patterns of the disease in the population. From the number of cases to the number of cases treated, to the number of deaths worldwide, all were stored as data. This data was used for predictive analytics of the virus. Predictive analytics makes speculations about future outcomes using data combined with statistical modeling and machine learning. It established when and under which conditions countries could expect increases, peaks, and reductions in cases and mortality rates. Such predictions helped health officials take preemptive measures against COVID-19. Moreover, genomic sequencing was used to take targeted public health action, react to variants, and efficiently contact tracing(Mckinsey). The United States had sequenced 200,000 cases, whereas the United Kingdom sequenced 350,000[18].

Tracking the Speed of the Virus

LexisNexis developed a model that produced weekly reports on tracking the speed of the virus[19].

Spread of the Virus

A SEIR model analyzed a data set of mobile-phone records for 98 million people providing location information to identify high-risk areas for virus spread[20].

Vaccine Effectiveness

Vaccine Safety Datalink (VSD) uses electronic health records to conduct near real-time monitoring of vaccine safety and effectiveness[21].

Monitoring Hospital Capacity

COVID-19 Hospitalization Tracking Project monitored and reported hospitalizations in the United States. It tracked trends like ventilator usage and ICU occupancy.

Big Data in Oncology

Oncology, the study of cancer, is a data rich field. Cancer is a complex disease that can cause death. The number of cancer patients is projected to increase by 26 million, by 2040[22]. A complete and detailed collection of data about every type of cancer is the key to understanding it: the symptoms people have, how their cancer is diagnosed, how they respond to treatment and how their own cancer progresses over time. Today, researchers have built models that can accurately predict molecular subtypes of cancers using radiomics, a machine-learning technique[23]. This can help identify, classify, and monitor solid tumors from CT, MRI, or PET scans, rather than relying entirely on radiographers and often-painful biopsies. Ultimately, this will lead to advancing drug discovery efforts and bringing new, precise medicines to patients, improving scheduling and access to care, enhancing safety and quality of care, and reducing the time between diagnostic procedures and treatment decisions.

Number of cancer patients is projected to increase by 26 million in 2040

Following are some analytical models that help in extract meaningful insights from oncology analysis:

ATOM Modeling PipeLine (AMPL):
(ATOM) Consortium, public-private consortium has developed AMPL,an open source, free-to-use software for building models that advance in silico drug discovery.

Joint Design of Advanced Computing Solutions for Cancer: It developed predictive artificial intelligence (AI) and machine learning models of drug responses in pre-clinical models of cancer.

Informatics Technology for Cancer Research (ITCR):
This program supports research-driven informatics tool development. It shares resources including tools for integrating and analyzing electronic medical records.

NCI Cancer Research Data Commons (CRDC) Resources:
These resources offer access to more than one million files of experimental and clinical data from landmark NCI studies.

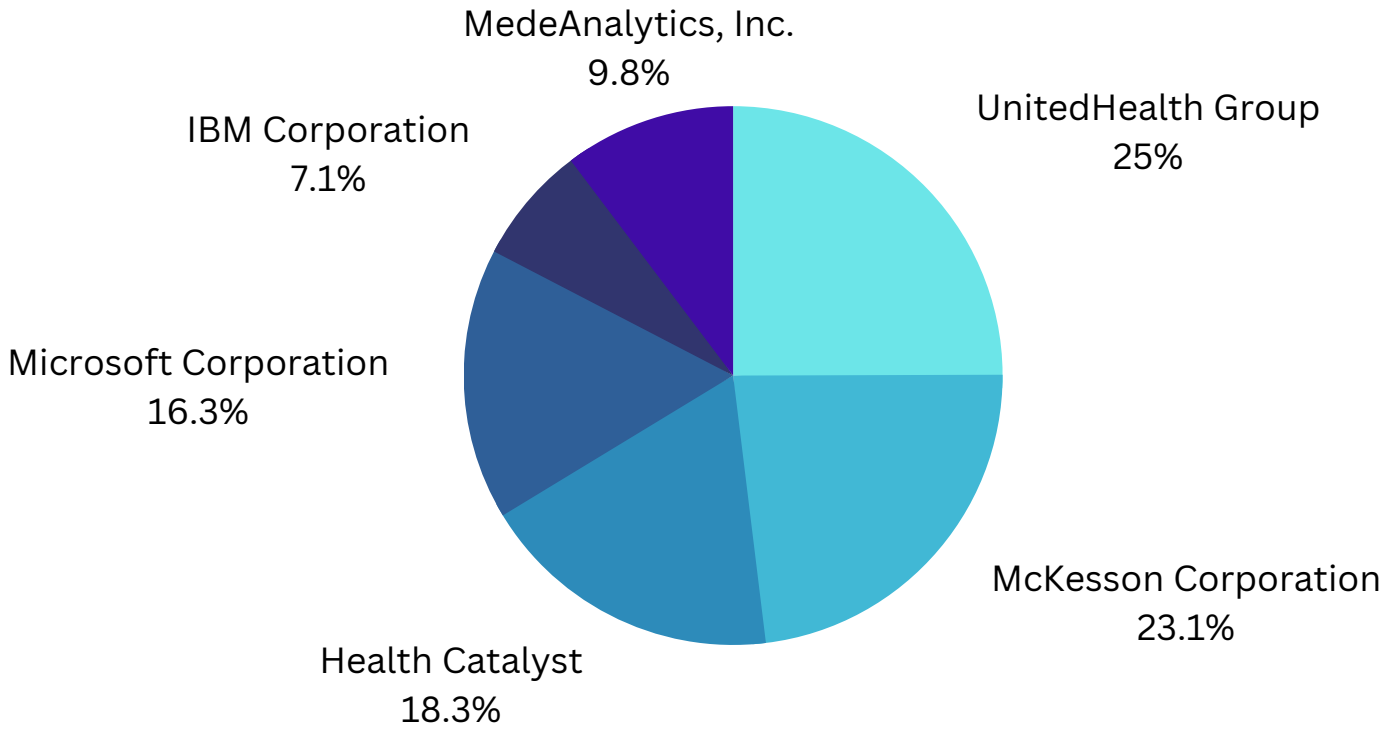
Global Demand for Healthcare Analytics

The market for Healthcare Analytics is being driven by the rise of big data in the healthcare industry. The expansion of the Healthcare Analytics Market is fueled by a rise in the deployment of big data in healthcare organizations and a surge in government initiatives to increase the adoption of electronic health records (EHRs) among healthcare companies.

Furthermore, the demand on healthcare organizations to reduce unnecessary costs has a beneficial impact on the market's growth. However, the Healthcare Analytics Market is projected to be hindered by factors such as high implementation costs and a scarcity of experienced workers. On the other hand, the increased acceptance of augmented analytics in the healthcare industry, as well as the use of cloud-based analytics across various healthcare providers, is likely to give lucrative prospects for market expansion throughout the forecast period.

Key Players in Global Health Analytics Market

The COVID-19 pandemic generated huge data that helped healthcare providers with identifying cities with maximum monitor patient pool, estimating bed and ventilator capacity, and predicting future events[24]. However, the scarcity of IT experts in the healthcare industry to operate complex analytics tools led to care gaps worldwide. To overcome this, various market players today are developing user-friendly health analytics tools. Below given are top 6 key players in the global healthcare analytics market:



Global Market by 2030

The Global Healthcare Analytics Market is valued at USD 33.80 Billion in the year 2022 and is forecasted to reach a value of USD 152.32 Billion by the year 2030[25]. The Global Market is anticipated to grow exhibiting a Compound Annual Growth Rate (CAGR) of 20.70% over the forecast period.

20.7% CAGR

USD 33.80 Billion in 2022

USD 152.32 Billion in 2030

Global Market by Regions

The increased prevalence of chronic diseases and the growing elderly population have necessitated the adoption of analytics tools by hospitals and other businesses. Asia-Pacific particularly will be the fastest-growing market, with rapid development, increased spending capacity, and a growing population all contributing to the region's rapid expansion. The following map shows the figures for health analytics market in major continents around the world.

Reasons for Increase in Global Demand for Healthcare Analytics

With the above statistics, the global demand will inevitably increase. The fast development and progression of the health industry have allowed for experimentation in every aspect of the relevant field. The healthcare sector has seen a drastic change in the past few years and paved the path for further innovation. In this background, it is important to highlight the reasons for how this change has come about.

1 Identify Cost Saving Opportunities

Despite the decrease in health services accessed in 2020 due to the COVID-19 pandemic. National health expenditures are expected to reach $6.8 trillion by 2030[26].

2 Chronic Disease Management

Healthcare analytics can develop effective prevention and management strategies, and monitor treatment outcomes.

3 Public Health Emergencies

Since 2011, there have been more than 1200 outbreaks of epidemic-prone diseases in 188 countries around the world. These are related to climate change hazards/disasters[27].

4 Growing Volume of Healthcare Data

Today, approximately 30% of the world's data volume is being generated by the healthcare industry. By 2025, the compound annual growth rate of data for healthcare will reach 36%[28].

5 Aging Populations

who need better and personalized treatments based on their medical history. The number of people aged 80 or over is projected to triple, from 157 million in 2022 to 459 million in 2050[29].

Challenges to Healthcare Analytics in the 21st Century

As with any industry working with big data, poor efficiency can lead to bottlenecking in healthcare. Bottlenecking is anything that restricts the flow of patients into and through the clinic system. For example, incorrect or invalid patient records could slow down hospital procedures. Bottlenecking could be fatal for some patients, too, who are in dire need of care and support. Following are some of the challenges rising in healthcare analytics today:

Low Quality of Data

Healthcare data is often incomplete, inaccurate, and inconsistent, which can make it difficult to analyze. Additionally, data is often stored in different formats and systems, making it challenging to integrate and analyze. For example data entry errors, incomplete data, and inconsistent data.

Lack of Data Uniformity

Healthcare data is often not standardized across different institutions, making it challenging to compare data and draw meaningful insights. For example data formats, data definitions, and data exchange are incompatible with each other across various data sets.

Threats to Data Privacy & Security

Healthcare data contains sensitive personal information, and it is essential to protect the privacy and security of patients' data. For example data access, data de-identification, and cyber security threats.

How to Maximize the benefit from Healthcare Analytics?

Data analytics in healthcare is becoming the new norm. With the rise in population across the world, healthcare demand is increasing. This means that more and more data will be available for practitioners that can be used to make informed decisions. Already, with the COVID-19 pandemic, the health industry realized the importance of analytics.

Today, fields like clinical analytics, population health analytics, medical image analytics, and genomic analytics are making it easier to get ahead of diseases in terms of their cure. The potential of analytics to predict outbreaks, detect anomalies, and disease control is untapped today mainly due to issues with data storage and privacy. To cater to this, below are some policy recommendations for practitioners in the healthcare industry in order to maximize the benefit from health analytics.

Improving Data Collection

Data collection is the ongoing systematic process of gathering, analyzing and interpreting various types of information from various sources. The most popular tools for gathering medical information include customer relationship management systems; electronic health record systems; and mobile applications that are used to

store information in the databases. Proper data organization, classification, and distribution lie at the core of improving data quality in healthcare. This can be done using management audits, maintain and update data in a correct format, and implement integrated data analytics.

Similarity in Data

At its base level, data standardization is the act of storing data in an agreed-upon format that allows for collaborative research, large-scale analytics, and sharing of tools and methods. A lack of patient data standardization can result in incomplete data collection, inaccurate reporting, missteps in patient matching, and slower workflows. For patients to receive the best care from their providers, those providers will need access to current, accurate, and comprehensive patient information. The Interoperability Standards Advisory and the Office of the National Coordinator for Health Information Technology are considered the authority for standards for American medicine.

Data Privacy and Security

Healthcare data privacy includes the policies and technology used to protect sensitive health data for medical clients and patients. Healthcare data privacy only allows authorized individuals, like doctors, to see sensitive patient medical data or protected health information. The U.S. Department of Health and Human Services Office for Civil Rights keeps track of and investigates the data breaches that occur each year. Today, as digitalization spreads rapidly, data breaches and cyber-attacks have become much more common and patient information has become more risky than ever before. For this, companies ought to implement data encryption and develop data access controls.

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