

# Health Analytics Types, Functions and Levels: A Review of Literature

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**Abstract.** Health analytics is a business-driven term that encompasses a wide spectrum of aspects and dimensions of business intelligence applications and big data analysis. Healthcare organizations recently are eager to know whether they are getting the full value from the massive amounts of data and information they already have, to achieve their strategic effectiveness goals and operational efficiency objectives. It is very crucial to learn more about the diverse functions, types and levels through which health analytics can support such tasks. A careful review of literature was conducted, and a qualitative analysis was used to classify health analytics. Five main types of analytics could be identified; these are descriptive, diagnostic, predictive, prescriptive and discovery analytics, each has its own distinct role in improving healthcare. In addition to the five types, health analytics could also be classified into three levels of performance and engagement, these are the operational, tactical and strategic health analytics.

**Keywords.** Health Analytics, Big Data, Business Intelligence, Hospitals.

## 1. Introduction

Health analytics is a business-driven term that encompasses a wide spectrum of business intelligence applications and big data analysis. This new concept is based on the availability and accessibility of data and information pooled through good integration and interoperability of a wide range of health information systems, such as electronic medical records, picture archiving and communication system, laboratory information systems and backend healthcare data warehouse systems [1]. Healthcare organizations are recently eager to know whether they are getting the full value from the massive amounts of data and information they already have, to achieve strategic effectiveness and operational efficiency [2]. The Healthcare Information and Management Systems Society defines health analytics as “the systemic use of medical data and related management information via the application of analytics methods and tools such as quantitative and qualitative statistics, context analysis and predictions to develop actionable insights and lead information based strategic and operational management for better healthcare” [3]. Over the last two decades, health analytics has emerged as a major area of study for both researchers and professionals, reflecting the magnitude of influence of information based management on solving problems and making decisions [4]. Health information systems are rapidly adopted worldwide, which will greatly increase the quantity and improve the quality of available health data.

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In the same time, revolutionary progress has been made in health analytics methods for analyzing enormous quantities of data and gaining new insights. Consequently, there are many new unmatched opportunities to use such methods to improve the quality and reduce the costs of healthcare [5]. It is very crucial to learn about the diverse functions, types and levels of health analytics through which it can support such tasks.

## **2. Methods**

A careful review of literature was conducted through searching multiple databases, including MEDLINE, EMBASE and Google Scholar. The main search terms used included Health, Healthcare, Analytics, Big Data and Business Intelligence. Out of 833 retrieved studies, only 56 studies were eligible for review. References of studies as well as recent studies that cite publications were examined. Qualitative analysis was used to classify the main themes of health analytics into distinct types, based on the functions discussed, and levels, based on the impact described in studies.

## **3. Results**

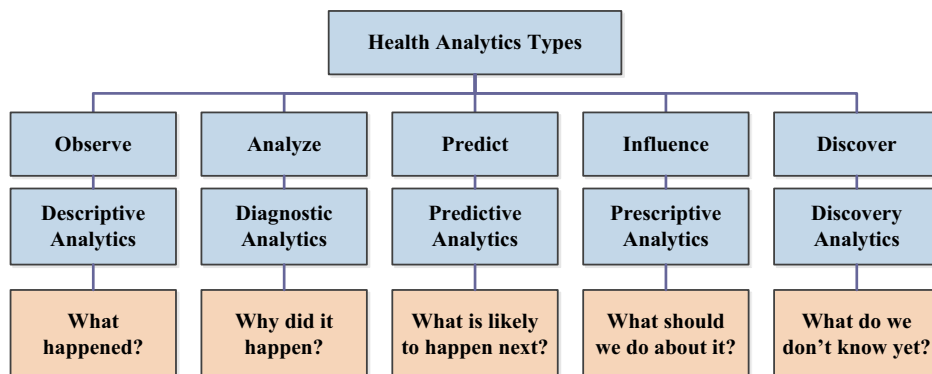
Five main types of health analytics could be identified; these include descriptive, diagnostic, predictive, prescriptive and discovery analytics. In addition, Health analytics could also be classified into three levels of performance and engagement; these are the operational, tactical and strategic levels analytics.

## **4. Discussion and Conclusion**

Health analytics is now moving from the operational level into the higher level of strategic analytics and from the simple descriptive toward the more sophisticated diagnostic, predictive and prescriptive analytics. In the very near future, hospitals and organizations that used descriptive and diagnostic analytics, to collect data on the performance of different services, will utilize the more advanced types of predictive and prescriptive analytics to choose among different feasible alternatives. The most advanced discovery analytics supports users to discover new scientific facts. The analysis needs huge volumes of data with plenty of detail to discover new knowledge [6]. Figure 1 shows the five main types of health analytics discussed.

Descriptive analytics is the easiest level to understand and use. It simply describes the data with no more inferential analyses, explorations or correlations between variables or information elements. It is completely data controlled. Descriptive analytics work by categorizing, characterizing, aggregating and classifying data to be converted to valuable information to help healthcare professionals understand and analyze decisions, performance and results. The presentation of data is usually in simple graphs and tables that show hospital occupancy rates, discharges, average length of stay and other related indicators. Data visualization is used to help answering specific questions or identify patterns of care, thus providing a broader view for evidence-based clinical practice. They allow managing real-time, or near real time data, or operational content, and capture all patients' visual data or electronic medical

records. This can identify previously unnoticed patterns in patients, related to hospital readmissions and support a better balance between capacity and cost [2,7].



**Figure 1.** Types and Functions of Health Analytics

Diagnostic health analytics works on answering why something happened. It needs extensive exploration and directed analysis of the existing data using tools such as visualization techniques to discover the root causes of a problem and help users realize nature and impact of problems. This may include understanding the impact of input factors and processes on performance. For example, the increased waiting time in providing certain healthcare services could be tracked down to multiple influential factors including patient related, provider related or organization related factors [8].

Predictive health analytics works in a more complex way than simple descriptive analytics. It focuses on the use of information rather than simple data. It examines existing past readings and indicators to predict future performance. A pharmacist may need to expect the amounts of a drug to stock in anticipation of an outbreak of an epidemic disease. Certain medical changes or clinical patient outcomes could be predicted and evaluated based on the enormous amounts of previously collected data, such as patient's length of stay; patients who might choose surgery; patients who likely will not benefit from surgery or would have complications or even mortality [9].

Prescriptive analytics role comes into action when decisions have to be made regarding a wide range of feasible alternatives, it enables executives not only to look into consequences and expected results of their decisions and see the opportunities or problems, but it also provides them with the best course of action to take advantage of that foresight in a timely manner. The success of prescriptive analytics depends mainly on the adoption of five basic elements; utilizing hybrid data, including both structured and unstructured data types, integrating predictions and prescriptions, considering all possible side effects, using adaptive algorithms that can be tailored easily to each situation in addition to the importance of robust and reliable feedback mechanisms [10].

Discovery analytics utilizes knowledge more than information or what can be considered as wisdom in discovering new medications or alternative treatments or detect new symptoms, signs or diseases or unknown side effects. The Data–Information–Knowledge–Wisdom hierarchy is based on filtration, reduction and transformation. Besides being causal and hierarchical, the scheme is pyramidal, in that data are plentiful while wisdom is almost nonexistent [11]. Health information systems provide horizontal clinical information at the individual level. Analyzing patient level

data can yield population level inferences and results, such as the strength of association between medical product exposure and subsequent outcomes. It is important to understand the value of knowledge discovery methods and the challenges in extracting clinically relevant knowledge from big medical data [12].

Health analytics can also be categorized into operational, tactical and strategic levels. Each has its own role in helping to improve organizational decision making. Operational analytics helps usually in routine situations where basic performance indicators are reported and visualized, in relation to daily operations. It could include a group of sub-types or categories, such as monitoring analytics and event driven analytics [13]. Tactical analytics usually works for longer term objectives and focuses more on results to assist management in handling visible problems, and usually includes simple predictive models which builds on past performance information, an abnormality in the waiting time of some ER patients maybe due to specific patient criteria. The hospital now should investigate this data to avoid future similar situations. So, we can identify the cause and find the solution [14]. Strategic analytics level can play a vital role in making long term decisions affecting the strategic direction of the organization. More complex systems and disciplines are needed for strategic analytics to become a key part of the organization's decision making. Strategic analytics also has a few sub-types or sub-categories such as predictive analytics, drill-down analytics, subject-matter analytics and comparative analytics [15].

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