APPLICATIONS OF BIG DATA IN THE HEALTHCARE

Khashimkhodjaeva Manzura
Sodikova Nigora
Tashkent University of Applied Sciences
https://doi.org/10.5281/zenodo.7751748

Annotation: The introduction of Big Data Analytics (BDA) in healthcare will allow to use new technologies both in treatment of patients and health management. The paper aims at analyzing the possibilities of using Big Data Analytics in healthcare. The article is based on a critical analysis of the literature, as well as the presentation of selected results of direct research on the use of Big Data Analytics in medical facilities. The following kinds and sources of data can be distinguished: from databases, transaction data, unstructured content of emails and documents, data from devices and sensors. However, the use of data from social media is lower as in their activity they reach for analytics, not only in the administrative and business but also in the clinical area. It clearly shows that the decisions made in medical facilities are highly data-driven. The results of the study confirm what has been analyzed in the literature that medical facilities are moving towards data-based healthcare, together with its benefits.
Key words: Big Data, information technology, Big Data Analytics, healthcare.

The amount of information — or data — healthcare organizations collect, manage and analyze has increased rapidly with advancements and integrations in technology. Technology, in turn, is changing the way the healthcare sector uses data. Advanced tools and software have been essential to the unprecedented growth of big data, making healthcare information easier and cheaper to store, access and use.

At one time, big data referred simply to large amounts of data. Since then, big data has evolved to become more broadly defined as clusters of information — data sets — too diverse, complex or massive to be handled efficiently by traditional data-processing application software. What is designated as big data can vary based on the tools and capabilities of people and organizations using it. As a field of study, big data explores how large data sets can be systematically managed and analyzed to extract or infer useful insights from them. Originally associated with three key qualities, big data continues to change and grow. Industry experts have widely adopted the 5 Vs to describe its characteristics:

- Volume is the amount or quantity of data. Technology has made it possible for unprecedented volumes of data to flow to and from devices, applications and networks.
- Variety is the different forms or types of data and their sources. Unstructured, semi-structured or structured data can include everything from numbers, facts and statistics to text, photos and videos.
- Velocity is the measure of how fast data is flowing — in other words, its speed. The velocity of data directly impacts organizations and their ability to make timely and accurate business decisions. With the Internet of Things (IoT) and other connected devices, machine learning and cloud computing, data flows in real time, so information can be available in an instant.
- Veracity is the inconsistencies and uncertainty of data. With data coming in different forms from different sources, the quality and accuracy of it has to be controlled to draw reliable conclusions from it.

- Value is how useful the data is and what's done with data to make it worth something. Value demonstrates data's return on investment.

Today, big data encompasses mathematical and statistical methods in data analytics. These include fields of predictive analytics, user behavior analytics or other advanced data analytics that uncover relationships and predict outcomes in large sets of data. Big data sets come from a variety of fields: banking and finance, business, media and communications, sports and entertainment and healthcare, to name just a few.

Healthcare analytics. Big data analytics for healthcare uses health-related information of an individual or community to understand a patient, organization or community. In the past, managing and analyzing healthcare data was tedious and expensive. More recently, technology has helped the healthcare sector make leaps and bounds to keep up with the flow of big data in healthcare.

Diagnostic devices, medical machinery, instrumentation, online services — sources such as these are transferring data throughout a healthcare network. This is done with the help of big data tools such as Hadoop and Spark.

Big data examples in healthcare. With a variety of data analytics tools and methods, healthcare analysts use big data to inform health prevention, intervention and management. Efforts such as these can help enhance the patient experience, improve efficiency and quality of care and lower healthcare costs. Big data analytics for healthcare makes it possible to get a more complete picture of something to make smarter decisions.

One of the most current and relevant big data examples in healthcare is how it has impacted the global coronavirus crisis. Big data analytics for healthcare supported the rapid development of COVID-19 vaccines. Researchers can share data with each other to develop advanced medications very quickly. Big data in healthcare also predicted the spread of disease by allowing healthcare information to be processed much more rapidly than in the past during other pandemics.

Big data in healthcare can benefit patients and providers alike in many different ways. Here are just a few other big data examples in healthcare:

- Patient outcomes. Big data can be used in healthcare to identify individual and community trends and develop better treatment plans or predict at-risk patients.
- Staffing and operations. Healthcare analytics can use big data to forecast patient admissions trends at specific times of the day and schedule the right number of staff during peak or slow periods.
- Product development. Big data in healthcare can help drive innovation and reduce the time it takes to bring a new product, such as prescription meds, to market.
- Strategic planning. Healthcare analytics can help compare chronic disease and population growth in neighborhoods to identify problem areas and plan additional services.
- Crime prevention. Healthcare analytics has helped streamline insurance claims processes, so providers can detect fraud more easily and patients can receive payments faster.

Challenges of big data in healthcare. As a relatively new field, big data in healthcare is still evolving to keep up with the fast pace and changing nature of technology. With such vast amounts of data available to work with, organizations and leaders can struggle with knowing where and how to start with data analytics in healthcare to find the information that is meaningful. Making use of all of this data raises concerns of healthcare cybersecurity and information privacy. The issue of governance — who owns and is responsible for overseeing the planning, implementation and management of big data — is also a common concern among healthcare organizations. Many healthcare organizations lack adequate systems and databases — and the skilled professionals to handle them.

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Considerations on use Big Data and Big Data Analytics in the healthcare. In recent years one can observe a constantly increasing demand for solutions offering effective analytical tools. This trend is also noticeable in the analysis of large volumes of data (Big Data, BD). Organizations are looking for ways to use the power of Big Data to improve their decision making, competitive advantage or business performance. Big Data is considered to offer potential solutions to public and private organizations, however, still not much is known about the outcome of the practical use of Big Data in different types of organizations.

As already mentioned, in recent years, healthcare management worldwide has been changed from a disease-centered model to a patient-centered model, even in value-based healthcare delivery model . In order to meet the requirements of this model and provide effective patient-centered care, it is necessary to manage and analyze healthcare Big Data. The issue often raised when it comes to the use of data in healthcare is the appropriate use of Big Data. Healthcare has always generated huge amounts of data and nowadays, the introduction of electronic medical records, as well as the huge amount of data sent by various types of sensors or generated by patients in social media causes data streams to constantly grow. Also, the medical industry generates significant amounts of data, including clinical records, medical images, genomic data and health behaviors. Proper use of the data will allow healthcare organizations to support clinical decision-making, disease surveillance, and public health management. The challenge posed by clinical data processing involves not only the quantity of data but also the difficulty in processing it.

In the literature one can find many different definitions of Big Data. This concept has evolved in recent years, however, it is still not clearly understood. Nevertheless, despite the range and differences in definitions, Big Data can be treated as a: large amount of digital data, large data sets, tool, technology or phenomenon (cultural or technological.

Big Data can be considered as massive and continually generated digital datasets that are produced via interactions with online technologies . Big Data can be defined as datasets that are of such large sizes that they pose challenges in traditional storage and analysis techniques. A similar opinion about Big Data was presented by Ohlhorst who sees Big Data as extremely large data sets, possible neither to manage nor to analyze with traditional data processing tools . In his opinion, the bigger the data set, the more difficult it is to gain any value from it.

In turn, Knapp perceived Big Data as tools, processes and procedures that allow an organization to create, manipulate and manage very large data sets and storage facilities. From this point of view, Big Data is identified as a tool to gather information from different databases and processes, allowing users to manage large amounts of data.

Similar perception of the term 'Big Data' is shown by Carter. According to him, Big Data technologies refer to a new generation of technologies and architectures, designed to economically extract value from very large volumes of a wide variety of data by enabling high velocity capture, discovery and/or analysis .

Jordan combines these two approaches by identifying Big Data as a complex system, as it needs data bases for data to be stored in, programs and tools to be managed, as well as expertise and personnel able to retrieve useful information and visualization to be understood .

While describing Big Data, it cannot be overlooked that the term refers more to a phenomenon than to specific technology. Therefore, instead of defining this phenomenon, trying to describe them, more authors are describing Big Data by giving them characteristics included a collection of V's related to its nature :

- Volume (refers to the amount of data and is one of the biggest challenges in Big Data Analytics),
- Velocity (speed with which new data is generated, the challenge is to be able to manage data effectively and in real time),
- Variety (heterogeneity of data, many different types of healthcare data, the challenge is to derive insights by looking at all available heterogenous data in a holistic manner),
- Variability (inconsistency of data, the challenge is to correct the interpretation of data that can vary significantly depending on the context),
- Veracity (how trustworthy the data is, quality of the data),
- Visualization (ability to interpret data and resulting insights, challenging for Big Data due to its other features as described above).
- Value (the goal of Big Data Analytics is to discover the hidden knowledge from huge amounts of data).

Big Data is defined as an information asset with high volume, velocity, and variety, which requires specific technology and method for its transformation into value . Big Data is also a collection of information about high-volume, high volatility or high diversity, requiring new forms of processing in order to support decision-making, discovering new phenomena and process optimization . Big Data is too large for traditional data-processing systems and software tools to capture, store, manage and analyze, therefore it requires new technologies to manage (capture, aggregate, process) its volume, velocity and variety .

The Big Data concept is constantly evolving and currently it does not focus on huge amounts of data, but rather on the process of creating value from this data . Big Data is collected from various sources that have different data properties and are processed by different organizational units, resulting in creation of a Big Data chain. The aim of the organizations is to manage, process and analyze Big Data. In the healthcare sector, Big Data streams consist of various types of data, namely :

- clinical data, i.e. data obtained from electronic medical records, data from hospital information systems, image centers, laboratories, pharmacies and other organizations providing health services, patient generated health data, physician's free-text notes, genomic data, physiological monitoring data [4],
- biometric data provided from various types of devices that monitor weight, pressure, glucose level, etc.,
- financial data, constituting a full record of economic operations reflecting the conducted activity,

- data from scientific research activities, i.e. results of research, including drug research, design of medical devices and new methods of treatment,
- data provided by patients, including description of preferences, level of satisfaction, information from systems for self-monitoring of their activity: exercises, sleep, meals consumed, etc.
- data from social media.

These data are provided not only by patients but also by organizations and institutions, as well as by various types of monitoring devices, sensors or instruments [16]. Data that has been generated so far in the healthcare sector is stored in both paper and digital form.

References:

1.Abouelmehdi K, Beni-Hessane A, Khaloufi H. Big healthcare data: preserving security and privacy. J Big Data. 2018.
2.Agrawal A, Choudhary A. Health services data: big data analytics for deriving predictive healthcare insights. Health Serv Eval. 2019.
3.Al Mayahi S, Al-Badi A, Tarhini A. Exploring the potential benefits of big data analytics in providing smart healthcare. In: Miraz MH, Excell P, Ware A, Ali M, Soomro S, editors. Emerging technologies in computing—first international conference, iCETiC 2018, proceedings (Lecture Notes of the Institute for Computer Sciences, Social-Informatics and Telecommunications Engineering, LNICST). Cham: Springer; 2018. p. 247–58.
4.Bainbridge M. Big data challenges for clinical and precision medicine. In: Househ M, Kushniruk A, Borycki E, editors. Big data, big challenges: a healthcare perspective: background, issues, solutions and research directions. Cham: Springer; 2019. p. 17–31.
5.Bartuś K, Batko K, Lorek P. Business intelligence systems: barriers during implementation. In: Jabłoński M, editor. Strategic performance management new concept and contemporary trends. New York: Nova Science Publishers; 2017. p. 299–327. ISBN: 978-1-53612-681-5.
6.Bartuś K, Batko K, Lorek P. Diagnoza wykorzystania big data w organizacjach-wybrane wyniki badań. Informatyka Ekonomiczna. 2
7.Bartuś K, Batko K, Lorek P. Wykorzystanie rozwiązań business intelligence, competitive intelligence i big data w przedsiębiorstwach województwa śląskiego. Przegląd Organizacji. 2018;2:33–9.
8.Batko K. Możliwości wykorzystania Big Data w ochronie zdrowia. Roczniki Kolegium Analiz Ekonomicznych. 2016;42:267–82.
9.Bi Z, Cochran D. Big data analytics with applications. J Manag Anal. 2014;1(4):249–65
10.Boerma T, Requejo J, Victora CG, Amouzou A, Asha G, Agyepong I, Borghi J. Countdown to 2030: tracking progress towards universal coverage for reproductive, maternal, newborn, and child health. Lancet. 2018;391(10129):1538–48.
11.Bollier D, Firestone CM. The promise and peril of big data. Washington, D.C: Aspen Institute, Communications and Society Program; 2010. p. 1–66.
12.Bose R. Competitive intelligence process and tools for intelligence analysis. Ind Manag Data Syst. 2008;108(4):510–28.