DATA SCIENCE - EXTRACTING INSIGHTS
Open Journal

*Review*

# The Role of Big Data, Analytics and Understanding in Cardiology

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***Article information***
**Received:** January 29th, 2024; **Revised:** February 28th, 2024; **Accepted:** March 22nd, 2024; **Published:** April 30th, 2024

***Cite this article***
Palak S, Mahesh VS, Hitesh SA, Patel H. The role of big data, analytics and understanding in cardiology. 2024; 2(1).
doi: https://doi.org/10.70705/ppp.dsei.2024.v02.i01.pp84-87

## ABSTRACT

Wearable, smart, and portable technology, among many others, aid the healthcare system in treating patients. The massive amounts of data generated by these devices need some sort of shaping in order to get actionable insights that may benefit both researchers and practitioners. When it comes to healthcare, there are a lot of different ways to accomplish this and get useful data. Additional data analysis for early patient care and treatment planning is being informed by this information. When patients receive treatment and care early on, it can improve their healthcare experience, which in turn can reduce healthcare costs, improve the quality of care they receive, and lessen the likelihood of errors and waste. This suggested study aims to help healthcare in general and cardiology in particular by surveying the literature on big data, analytics, and insights. Researchers and practitioners in the fields of healthcare and cardiology might use the provided study as a starting point for new ideas for early care.

## INTRODUCTION

Data has to be structured in order to extract valuable insights for study and practice from the vast amounts of data generated by the proliferation of smart devices like sensors, actuators, wearables, and others. With more data available, researchers may face new obstacles in sifting through it all to get what they need. Successfully drawing these insights allows for early and effective therapy, which in turn improves patient care. The challenges posed by big data and analytics in healthcare, and cardiology in particular, have prompted the development of a wide range of strategies, tools, and techniques.

When it comes to healthcare decision-making and service, data processing and information have long played an essential role. Big data in medicine is a byproduct of healthcare IT and communication. A wealth of information from various industries, including healthcare equipment, medical insurance, medical research, and life science, is provided by healthcare providers and the hospital business. There is a vast quantity of data available, which might be useful for healthcare and medical procedures. Numerous opportunities exist for transforming this data into expressive and actionable insights to help decision-making through the combination of AI, advanced analytics, and machine learning. On the clinical side, this has the potential to save lives through the development of services and procedures, the improvement of resource utilization, and the reduction of maintenance and financial expenses, while on the financial front, it can make high-quality, real-time situation-responsive patient care available [1, 2].

As a result of developments in cutting-edge methods, such as analytical tools and strategies, those involved in healthcare may define the greatest accomplishment for the present circumstance by connecting data power with past data and using predictive analytics to forecast future results [3, 4]. In the past, doctors and other medical professionals treated patients by drawing on their own personal records and other confidential information they had access to. Access to data from many sources addresses the opportunity to have a comprehensive understanding of patient health. In order to provide exact care, it is necessary to have access to the right information at the right moment, and using state-of-the-art technology on top of such data helps with that [5].

The literature on big data, analytics, and insights is reviewed in the proposed study. The popular libraries were searched in order to collect related materials for the suggested study. Researchers and practitioners in the fields of healthcare and cardiology might use the provided study as a starting point for new ideas for early care.

Here is how the rest of the paper is structured: In Section 2, the relevant research that is relevant to this investigation is presented. The methodology for the proposed study's library search is detailed in Section 3. After Section 4, the paper is concluded.

## 2. Related Work

Several approaches have been in practice to tackle diverse issues of big data and its analytics in healthcare. Pevnick et al.[6] offered a review that discusses the current and upcoming devices intended for measuring the actions of heart rhythm, heart rate, and thoracic fluid. Various frameworks were presented, which classify and understand the wearable de- vices. Mehta et al. [7] presented a systematic mapping study for analyzing and identifying the research studies on ana- lytics of big data and use of artificial intelligence in healthcare. The study identified 2421 papers for the year's ranges from 2013 to February 2019. These papers were evaluated, and the results show that the study will support the necessity in the use of technologies in healthcare. Ati- tallah et al. [8] surveyed the literature associated with the DL and IoTapplications for smart cities' developments. Initially, the basics of IoT were defined followed by the characteristics of IoT-produced big data. After that, the various structures used for analytics of IoT big data were presented. The common DL models were surveyed and reviewed the current research employing the IoT and DL for developing services and smart applications for smart cities. The existing issues and challenges encountered throughout the smart city's development were outlined. Kazmierska [9] presented a study on the needs of community in translating multisource data into clinical decision aids.

Ben-Assuli et al. [10] demonstrated power prediction of four popular algorithms and matched their accuracy in congestive heart failure predicting initial patient mortality. The results show that the current models outperform those described in the literature. The results further support the policy-makers in allocation of resources for establishment of comprehensive systems of integrated health IT aiming at simplification of analytics of ML. Dipti Itchhaporia [11] analyzed the existing application and state of machine learning approaches and artificial intelligence in cardio- vascular medicine. The e□ ects of emerging technologies on cardiovascular medicine are emphasized for providing un- derstanding to the clinical practice and to find probable patient assistances. Nazir et al. [12] provided a wide-ranging overview of the available big data studies in cardiology. The study followed a protocol of systematic literature review for presenting the published material from 2008 till 2018 as- sociated with big data features, applications, and analytics in cardiology field. The authors identified 190 potential studies and analyzed them. These studies were published in con- ferences, books, journals, and many other online materials. The study was presented as an evidence for the researchers and practitioners to devise novel solutions in the area of interest. Nazir et al. [13] presented a comprehensive review of the 10 years from 2008 to 2018 associated with the vi- sualization of big data in the area of cardiology. The study identified 53 prospective papers related to visualization of big data in cardiology. The study was based on protocol with defined research questions, inclusion and exclusion criteria, and quality criteria. These identified studies were analyzed according to the defined research questions. The study highlighted the increase of the number of researches in the area and focused on further research and innovations in the field. These studies were done in order to support the usage of big data in healthcare.

Bizopoulos and Koutsouris [14] surveyed applications of deep learning that uses structured data and signal and imaging modalities from cardiology. The benefits and lim- itations of applications of deep learning in cardiology and in medicine in general are discussed. Cannie`re [15] examined the developments of heart rate variability factors during short-term interval all the way through cardiac rehabilita- tion. Electrocardiography signals, documented with the help of wearable device in 129 patients following cardiac reha- bilitation program, were analyzed. The findings of the study present appreciated insights into disease monitoring during cardiac rehabilitation in future application.

## 3. Library-Based Search Process

This study offers to present an overview of the existing approaches and methods for big data, its analytics, and insights in cardiology. Various popular libraries such as ScienceDirect, IEEE, Springer, and Wiley were searched with the aim of obtaining associated materials interconnected to the current study. The information gathered from these libraries was analyzed and presented from different perspectives in the form of different tables and figures. This information includes the type of article, number of publi- cations, topics covered, subject areas, and publication titles. Initially, the library of ScienceDirect was checked and the following information was obtained. Figure 1 depicts the types of articles with publications. The figure shows that a bigger number of publications were in the form of research article.

Figure 2 presents the articles in total with the given year. More publications are shown in the year 2020, which shows the increase in number of researches.

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