

# BIG DATA ANALYTICS & ARTIFICIAL INTELLIGENCE IN MANAGEMENT OF HEALTHCARE: IMPACTS & CURRENT STATE

SAZU Mesbaul Haque<sup>1</sup> and JAHAN Sakila Akter<sup>2</sup>

<sup>1</sup>Case Western Reserve University, USA, [mesbaul.sazu@case.edu](mailto:mesbaul.sazu@case.edu) ; ORCID <https://orcid.org/0000-0003-3489-9416>

<sup>2</sup>Independent University, Bangladesh ; [1720714@iub.edu.bd](mailto:1720714@iub.edu.bd) ; ORCID <https://orcid.org/0000-0002-0285-0530>

## ABSTRACT

**Background:** Healthcare is a very complex area that is ingesting data at an unprecedented speed. Within the health care industry, there's an abundance of data; data from physicians and hospitals, medical research, medical insurance, medical equipment as well as life sciences keep flowing at a high rate. The improvement of technologies opens doors to huge possibilities for using the data found in health care for transforming the management of healthcare.

**Research gap:** A lot of research have been conducted to study the significance of data analytics in general healthcare, but there's a gap to research the importance of data analytics in the field of healthcare management as well as its current state of development.

**Novelty:** The study, through employing structural mapping, focuses on evaluating the available research to offer proof that will encourage further application of data analytics in the healthcare field.

**Methodology:** An organized structural mapping analysis of 1241 studies was carried out to identify as well as evaluate the application of Big Data Analytics and Artificial Intelligence in healthcare.

**Future scope:** This study is going to identify the areas which need further study for the use of data analytics in healthcare. This study will likely provide a potential base for future researchers to conduct further research.

**KEY WORDS:** Management, Data Analytics, Artificial Intelligence, Healthcare, Performance

## 1. INTRODUCTION

The improved digitization of healthcare results in the incredible volume of data generating from various other sectors of the health care business, like healthcare research, medical insurance, and medical equipment. The development of data analytics, as well as machine learning methods offer various possibilities for converting the data directly into meaningful insights to decision-making, offer good quality patient treatment, respond to real-time conditions (Jiang at al., 2017). It also improves utilizing resources, enhances services and procedures, as well as reduces the cost on the operational and financial side. Healthcare stakeholders can make use of the data with analytical solutions, not simply of the analysis of historic data (descriptive analytics) but also for forecasting future results (predictive analytics also).

Standard medication process depended on a doctor's specific knowledge as well as their previous encounters of dealing with similar patients. The capacity to deal with this complex data is beyond the abilities of conventional analytical resources (Hermon, Williams, 2014). Big data analytics, as well as artificial intelligence, might be utilized to get prepare data and generate insights which will perform an important role to improve healthcare (Ambigavathi, Sridharan, 2018). Predictive analytic methods can be utilized to figure out hereditary illness markers and types; and develop brand new medicinal drugs as well as assess their effectiveness. Strategies in healthcare research as well as well as insights developed from big data provide an enormous opportunity to improve the performance of healthcare (Mikalef et al., 2018). A lot of study research has contributed to the usage of artificial intelligence as well as big data analytics in healthcare, although the study continues to be

mostly spread on the utility of artificial intelligence (Choi, Wallace, Wang, 2018). We show the outcome in our mapping research within these papers by offering a comprehensive introduction as well as a summary of the analysis which demonstrates how big data can affect management of healthcare. The study is structured in five parts, part one, explains the analysis strategy, part two, procedure employed for this specific analysis. The 3rd part shows the results of the conducted analysis for big data in healthcare. The 4th part evaluates the result as well as the further studies and limits of the structural mapping. The conclusion of the analysis is offered in the last part (Wang, Hajli, 2017).

## 2. METHODS OF RESEARCH

The study was carried out in the following steps: a) Defining the research questions, b) recognition of search terms and carrying it out, c) based on criteria, screening research papers d) development of classifying criteria and setting up primary keywords e) extracting data and structural mapping.

### 2.1. Meaning of research questions

The objective of this examination is to figure out evidence the big data analytics, artificial intelligence, and then machine learning in healthcare. The main research issue governing the research is: What is the existing expression on the study regarding big data analytics as well as artificial intelligence inside the field of healthcare? This may lead to the following goals: (a) to assort into classes the current study findings with technologies that are innovative in healthcare; (b) to figure out the trends within the research and (c) to highlight directions for future scientific studies.

Five research questions are produced from the objectives. Responding to the queries provides a summary of techniques through this area, that could lead people to succeed in manufacturing as well as academic activities. The analysis accounts for the explanation of theirs are discussed below:

Research Question one: Which scientific studies are done within data analytics as well as artificial intelligence of healthcare? Rationale: this intends to figure out the suitable research performed within this field. The means to address this kind of problem can assist sorting data into classes based on research method put on towards the scientific studies, which range from opinions and perspectives to analysis of scientific studies (Kumar, Sood, 2020).

Research Question two: What types of work are concluded by research relevant to big data analytics as well as artificial intelligence of healthcare? Rationale: The study uses the type of efforts created by the scientific studies. It attempts to highlight the results the study attempts to address within the area of review. These efforts differ from models and structures to tools and methods for utilizing big data answers in healthcare. The means to address this kind of problem enables checking out the strength of searching within this specific field, using the presumption that original research initiatives may possibly focus on theoretical growth as well as principle, while more mature analysis parts may possibly focus on setup, validation, and then analysis of suggested tools and methods (LaValle et al., 2011).

Research Question three: Which facets of healthcare do the data strategies as well as artificial intelligence emphasis upon? Rationale: the intention is to evaluate the studies exhibiting the spread of research endeavours throughout different areas of healthcare. By responding towards the issue, the analysis seeks to take ahead the different areas of healthcare in which workouts, as well as research initiatives, are utilized as well as understand the fields in which the additional evaluation must be guided (Khanra et al., 2020).

Research Question four: What are this scientific research focused around? Rationale: This seeks to spotlight research depth and width. The ideas powering this study is generally to figure out the secondary field of searching aside from the key facets of healthcare that the scientific studies focus on. This was checked out because a few the tests had their emphasis segregated in more than one area of research and also consequently must certainly be classified within equal organizations (Janssen, van der Voort, Wahyudi, 2017).

Research Question five: How has got the groundwork been created within big data analytics as well as artificial intelligence for healthcare? Rationale: the aim of the issue is to present the division of searching through the years. This makes it possible for the finding of present global fashion within the niche coming from the point of view of researchers (Wang et al., 2016).

## 2.2. Conducting the research

For being able to recognize the correct scientific tests to reply to the prior research concerns, we began with formulating the key phrases, picking out the data resources, as well as performing the search engines.

## 2.3. The search engines criteria

### 2.3.1 Population

Inside the context of the study of ours, the population is healthcare big data analytics, machine learning, artificial intelligence, as well as related solutions. As mentioned by the

specifications, key phrases are classified into sets as well as the synonyms of theirs are already deemed to create the SEO string. Search key word one: primary keyword phrases relating to public - health care i.e., "healthcare", "medicinal drug", "medicine" "and "health" "medical". Search key word two: treatment associated phrases - big data analytics, artificial intelligence as well as machine learning i.e., "big data", "data analytics", "analytics", "machine learning", "data science", "artificial intelligence", "analytics", "deep learning" and "neural network"

### 2.3.2 Data resources as well as selection process

In line with the keyword phrases determined for SEO, a pair of queries was conducted on three electronic databases: Springer, ScienceDirect and EBSCOhost. This analysis was carried out during March 2021, considering the articles from 2015 to 2021.

### 2.3.3 Assessment of papers

The initial evaluation of written documents was finished throughout the research progression (table one) whereby display the screening considering the inclusion as well as exclusion requirements. The tests had been subsequently chosen based on their title of the paper, abstracts of them too, and finally keywords.

### 2.3.4 Review focus

Defines the primary element of healthcare which every analysis focus on. To assort into classes the part of healthcare that the article is pivoted on, a scheme was developed by figuring out the context of the research.

### 2.3.5 Review attribute

Presents the 2nd field which the write-up relies on. Since several tests did not explicitly highlight at least one domain of healthcare, the analysis attribute assort the publications into classes.

### 2.3.6 Year of publication

This provides the frequency distribution of research throughout several publications yrs. (2015-2021). This allows setting the design of searching within the area of big data analytics, artificial intelligence, and then machine learning in healthcare.

## 2.4. Data removal; mapping of results

As soon as the different search was conducted, the data was extracted, and the chosen posts have been categorized based on this program (Akter et al., 2016). Throughout the data removing process, a category pattern was made up with the addition of new organizations or perhaps changes of pre-existing organizations (Sun, Reddy, 2013). The written documents were sorted using a spreadsheet to go into several forms, this allowed additional analysis for combating research concerns. The results of categorization had been to find out how frequently articles were published. By utilizing the wavelengths as well as blending research concerns, a chart was generated with the goal of supplying a review of the usage of big data analytics in healthcare.

## 3. ANALYSIS OF MAPPING RESULTS

In between 2015 as well as 2021, an optimum of 1241 research articles have been published concerning the usage of big data analytics as well as artificial intelligence found in healthcare. Outcomes of mapping are analysed as well as supplied within the context of research concerns. This allows us to evaluate various facets of research and therefore polish an extensive

perspective of all the topic. This offered a lucid perspective on the connection between concerns which are unique and likely address research gap. As being used, the results gathered throughout the mapping research as well are assessed concerning issues.

### 3.1. Types of research (RQ1)

Main scientific studies are categorized based on research types. Outcomes demonstrated that most of research utilized assessment analysis. 67.23 % of overall research articles created by this method. This research has checked out the improvement of algorithms, methods or models as well as their conclusions. Analysis of uses in various aspects of healthcare. Generally, there were posts of healthcare dynamics which accounts for 22.12 %. Opinion based research articles consist of research testimonials as well as analytic method of a problem. (3.21%) consists of validation analysis (2.12 %), solution proposition (3.12 %), and also learning tools (1.54 %) are contained in this specific article procession (0.20 %). These results show the point that as a result of the scientific, the area of research is established within a greater proportion. Analysis studies research strategies as compared to some other research techniques.

### 3.2. Efforts (RQ2)

In accordance with the research work, the group of main scientific studies demonstrated the very best of research offered

| Classification | Explanation  |
|----------------|--|
| Architecture   | Research that provides an overview of the fundamental organization of a system which comprises of its components and the relationships between them            |
| Framework      | Research that suggests a real or conceptual structure which serves as a base for building/ re-building a software within a narrowly defined application domain |
| Method         | Research that proposes a procedure or technique for applying big data technology in healthcare.  |
| Metric         | Research that presents a “quantitative measure of degree to which a system, component, or process possesses a given attribute”                                 |
| Model          | Research that produces a conceptual or mathematical model for solving a particular problem.  |
| Platform       | Research that provides hardware or software for hosting an application or a service.   |
| Process        | Research that defines a set of activities that need to be performed for solving a particular problem.  |
| Strategy       | Research that recommends a plan or scheme for achieving a long-term goal.  |
| System         | Research that describes the elements and components of computer created to carry out a specific activity.  |
| Theory         | Research that offers a set of principles to explain a phenomenon on which a subject of study is based.   |
| Tool           | Research that develops an algorithm, a software program or utility which helps in software development or system maintenance                                   |

**Table 1:** Contribution of each category

### 3.4. Review attribute (RQ4)

The evaluation cantered on research themes where primary scientific tests. The reason highlighted the secondary dimensions and depth of research which this scientific research stressed aside from the primary goal of searching. Outcomes show that most of the research highlighted the medical specialty, developing 63.21 % of the key scientific studies. 22.13 % of articles stressed on overall health program. Here, the primary scientific tests had been additionally classified as a different area of expertise within the medical area of expertise.

### 3.5. Publication yrs. (RQ5)

The data posts belonging to this specific analysis were analysed by the entire year of their publication, to acquire trend of research on the use of big data analytics as well as artificial intelligence in healthcare, Results reveal that research within this specific field has progressed through 2015 to 2021. The research in healthcare started with a single publication in 2015

(31.02 %). Of the entire scientific studies, 26.02 % contributed to the idea. The contribution to the technique created 22.47 % of overall scientific studies. Various other efforts, though much less considerable, consist of the tools and equipment while 8.71 % consists of the method, 4.18 % designs, 3.84 % structure.

### 3.3. Review focus (RQ3)

The outcomes on the structural mapping demonstrated that patient care has become increasingly important for a lot of research, accounting for 61.92 % of all publications. The next majority is, with 18.05% of publications, managerial/organizational emphasis. 99.19 % of the tests offered an introduction on the use of big data analytics, artificial intelligence as well as machine learning in healthcare. Research work associated with healthcare science created 7.12 % of all publications. Table 1 below shows the contribution of each category and a brief explanation of them. Subcategories for above-mentioned goal are already derived to restrict the focus of significant scientific tests.

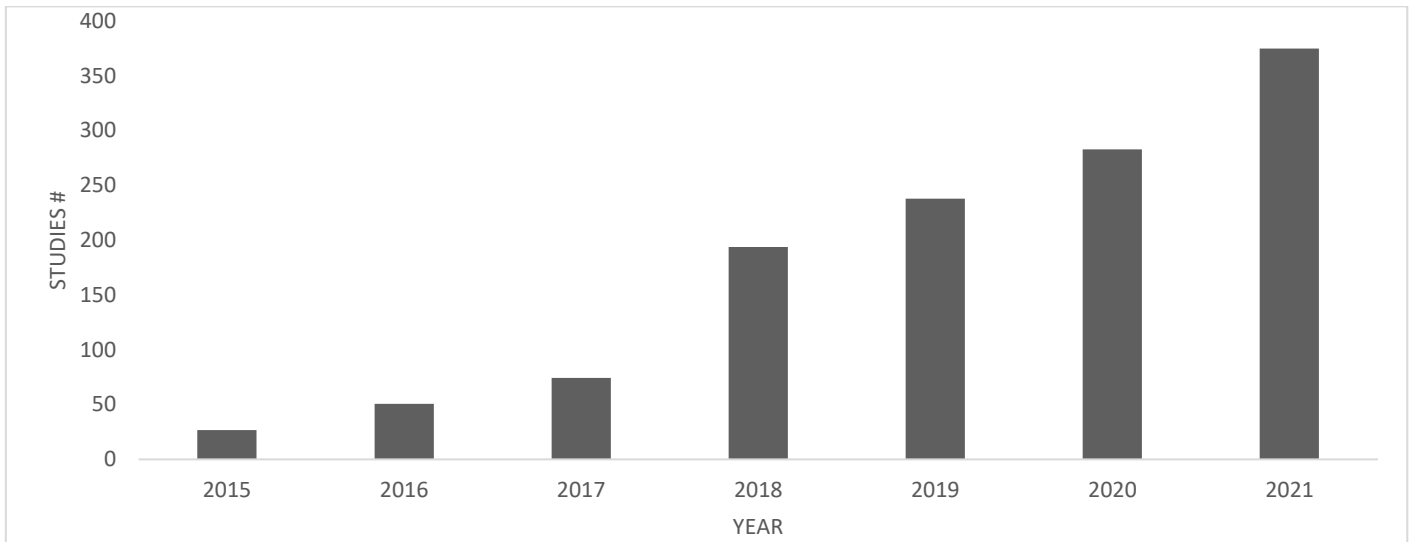
(0.04%) and observes a growth of publications through the years. Probably the most substantial contribution was present in 2021 with 43.20% publications, which had been far more compared to a 21.2% from the prior yrs. The highlight shows the advancement of the latest research passions. Furthermore, the data showed that 2021 had seen 17.30 % rise and it is expected to increase more.

## 4. RESULT AND DISCUSSIONS

### 4.1. Key findings

#### 4.1.1. Development analysis:

The structural maps show the mapping overview of big data analytics as well as artificial intelligence found in healthcare. This analysis suggests that application of new technologies in the health care is useful for providing better healthcare as well as management of healthcare.



**Figure 1** The number of studies on healthcare using machine learning, data science, & big data analytics over time

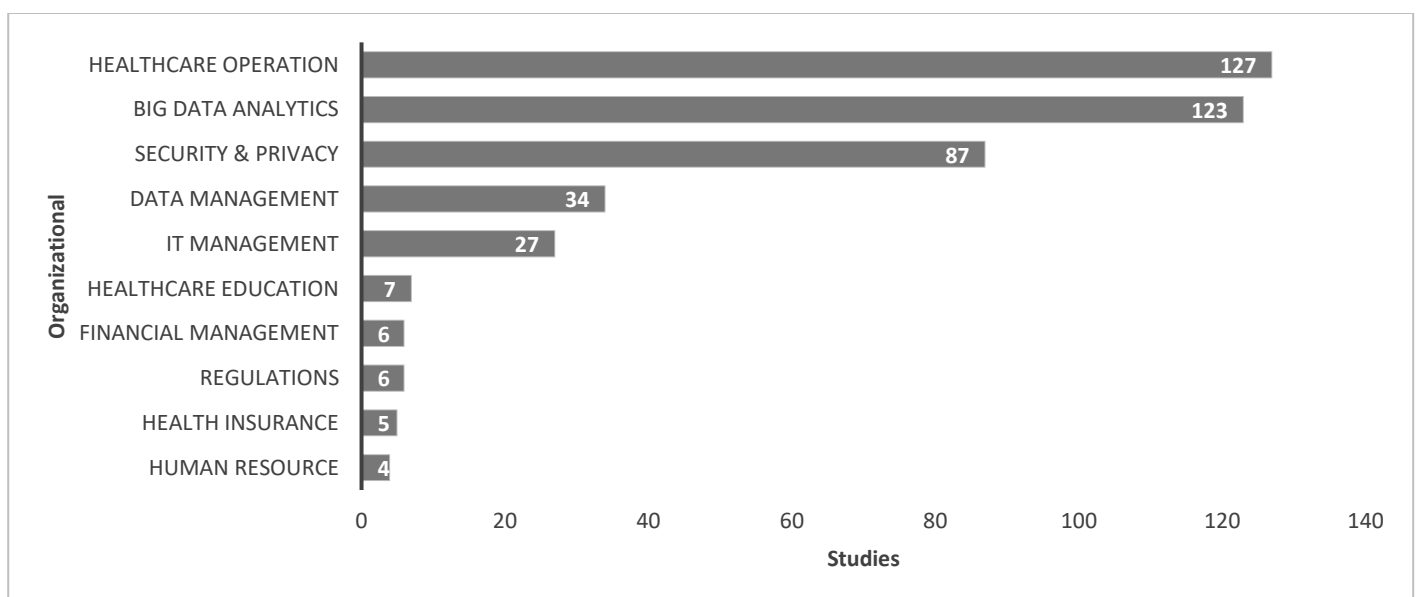
While generally there continues to be a visible emphasis of research on persevering patient care (sixteen occasions much more in 2021 than 2015) as well as health care management (eight occasions more in 2021 than in 2015), the research of healthcare application has substantially progressed, as revealed within the fig. 1. The outcome of this mapping presents crucial research with sizable improvement in each of the yrs. Research on the program attribute confirmed smaller sized development (six occasions much more in 2021 than 2015), while everything these focused entirely on technical attribute and the research discovered a big boost (twelve occasions more in 2021 than 2015).

To conclude, the outcomes of this structured mapping evaluation indicate improving fascination with the development of empirical research scientific studies through the long-time within the use of revolutionary solutions in deep healthcare.

#### 4.1.2. Primary focus of the studies

The study within mapping analysis suggests diverse focus on various fields of healthcare. Focus of the research as well as attributes were utilized to evaluate the scientific studies (Shamim et al., 2019). To understand the focus areas of research, subcategories of the research studies have been analysed. It was found out that researchers have tremendous focus at the use of big data analytics as well as artificial intelligence for healthcare as shown by number of studies conducted in each subcategories image processing (582), decision management (521), operations, and healthcare (127) as shown within the fig. 2. In addition, 122 research was discovered the utilization of complex

analytics for textual research as well as evaluation, of which nineteen research had natural language processing for evaluation. Furthermore, the evaluation of the results discloses the most considerable health-related areas of expertise together with the use of artificial intelligence as well as big data analytics.



**Figure 2** Segmentation of studies across management and organizational departments

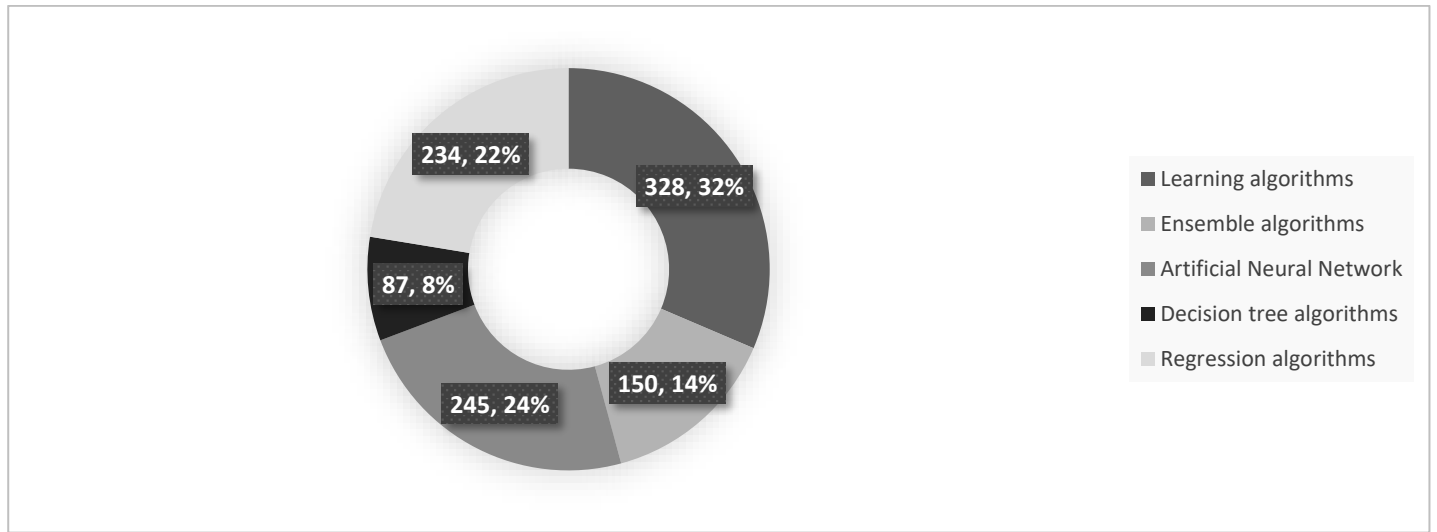
The outcomes of this evaluation show the utilization of various methods as well as algorithms for analysis of overall healthcare data. Most typical algorithms are learning algorithms (328),

regression algorithms (234), ensemble algorithms (150), artificial neural network algorithms (245), as well as decision tree algorithms (86), as displayed within the figure 3.

## 4.2. Discussions

With the intention of comparing the contribution of this study in the context of literature, results of this research with relevant scientific studies have been compared. Since the aim of the

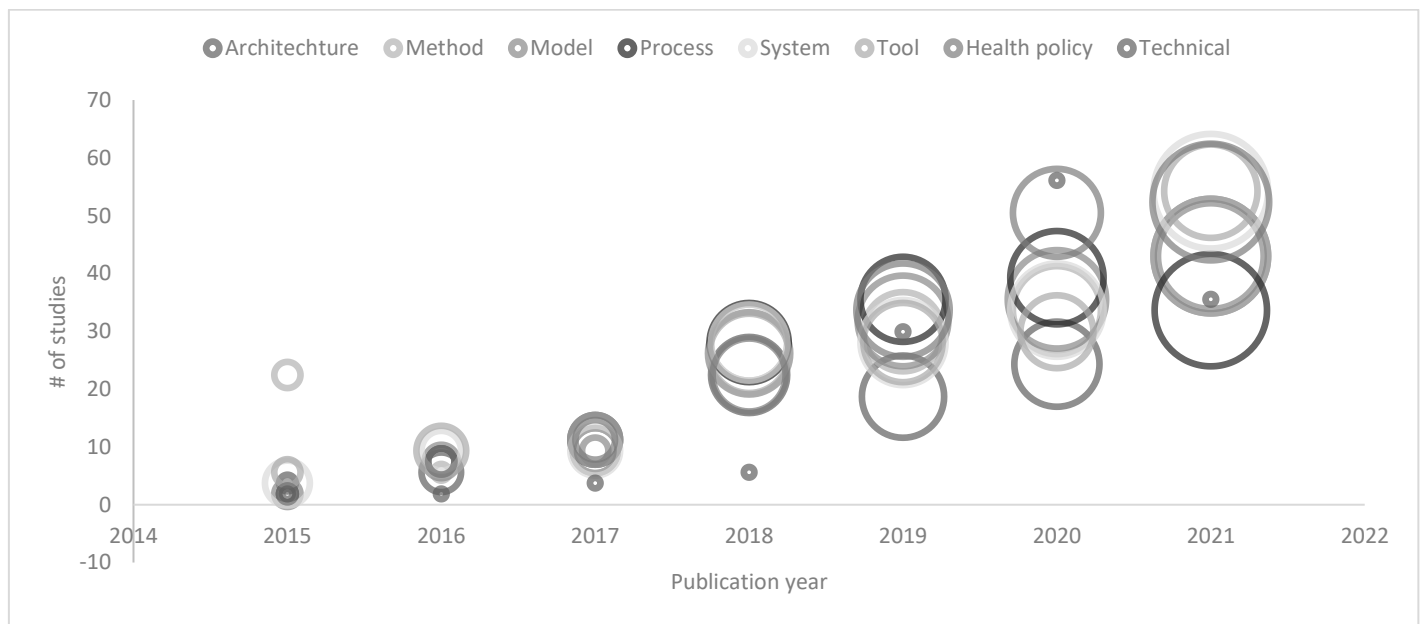
assessment was to study the research on the use of big data analytics and artificial intelligence for healthcare, the comparability concentrates primarily on the results of the findings.



**Figure 3** Different algorithms in machine learning, data science, and big data analytics

Even though each of the experiments differs somewhat in their scope and focus, they offer an extensive perspective of the use of artificial intelligence in healthcare. The evaluation research

by Jiang et al. (2017). focuses primarily on the demand for artificial intelligence in healthcare, the types of data examined, together with the forms of diseases which are handled utilizing artificial intelligence.



**Figure 4** Research studies focus

On the other hand, this structural mapping analysis seeks to determine as well as synthesize all the relevant publications on the use of big data analytics as well as artificial intelligence in healthcare, in order to depict the state of research by reviewing several characteristics in this specific area (Wang, Hajli, 2017). Apart from looking at the interest of research group in using big data analytics as well as artificial intelligence in the evaluation of different kinds of medical data, techniques and algorithms; this particular mapping assessment explores essentially the most widely used investigation tactics as well as efforts of the publications. Moreover, by gathering publications from Science Direct, EBSCOhost and PubMed directories, this assessment analyses 1241 main scientific studies in the context of big data

analytics as well as artificial intelligence in healthcare, including medical studies published till December 2021. As confirmed in the evaluation by Jiang et al. (2017), this mapping study additionally exhibited cultivating research interest in the use of big data analytics as well as artificial intelligence in healthcare. As for the usage of the tools in the study of different data types, this particular research discovered prevalent use in healthcare image processing, biological signal processing, text mining, along with genomic evaluation. While the results of an evaluation by Jiang et al. (2017) likewise present bigger usage for imaging, it's apparent that technologies' program in signal processing, as well as text evaluation, has acquired increased interest after 2017. Equivalent to the results of the research by Jiang et al. (2017), this analysis found that oncology, neurology,

and cardiology will be the top medical specialties where big data analytics and artificial intelligence are used. However, the medical specialties of pulmonology, endocrinology, then ophthalmology are showing growing interest in using big data over the past couple of years.

Jiang et al. (2017) likewise found the systems applied for the analysis of medical information and categorized them into three classes: machine-learning methods, NLP methods, and deep learning techniques. A comparison of the results demonstrates a convolutional neural network, a neural learning algorithm, whose application was insignificant in earlier years, has observed growing interest from 2015 to 2021. It's probably the most utilized algorithm in the literature. Outcomes of research by Jiang et al. (2017) demonstrate that the following most popular mechanism is the neural network, while this analysis discovered reduced the use of the random forest algorithm in earlier research, but its prevalence has grown after 2017 which forms the 3rd the largest contributor among algorithms applied to the study.

The evaluation research by Jiang et al. revolves mostly around the systems employed for the evaluation of medical information as well as disease. On the other hand, our study stretches the end result by classifying the use of big data analytics and artificial intelligence based on different aspects of healthcare. The bulk of the investigation provides visibility to the enhancement of patient care, particularly in decision support and also through the evaluation of physiological signals and medical images. An additional area with sizable research scope is healthcare management, information management, and control of big data.

#### 4.3. Limits

This piece spotlights the limits of the structural mapping.

(a) Selection bias: It refers to the possibility of the data being incorrectly provided or perhaps excluded as a result of the mapping evaluation process. Inclusion and exclusion criteria were setup to reduce this.

(b) Incompleteness: An additional risk to the validity of the research is going to be the incompleteness of the search. Due to the inaccurate or incomplete variety of articles, this can happen. Even though the structural mapping is utilized, few pertinent scientific studies might be ignored when posted outside the scope. For dealing with this, the directories have been browsed. Even though steps were taken to handle the challenge, there's nonetheless a limitation on the possibility of skipping some publications.

#### 4.4. Future research scope

Applying the outcomes of this structural analysis have ramifications for future researchers that are interested in the big data analytics in the healthcare space. The article additionally offers comprehensive information regarding the practitioners who are engaged with the usage and advancement of big data analytics as well as artificial intelligence techniques for enhancing health care expertise. As this analysis offers an introduction to the big data analytics in healthcare, it enables researchers to identify the areas where further research can be conducted.

The study framework offered a considerable start to the current state and development in the field of big data artificial intelligence as well as data analytics for healthcare. The research focus could be widened to new publications. This can allow the

healthcare stakeholders as well as providers to select the best instrument for their specific area.

## 5. CONCLUSIONS

To conclude, making use of big data analytics as well as artificial intelligence plans to enhance health care quality, as well as handle a variety of facets of the device, is incredibly essential for improving the use of appearing solutions in healthcare. Advancement of applications that can certainly effectively help support healthcare and enhance the calibre of ancillary hygiene products will in fact add to big-scale adoption, because will the research on the practical use as well as competence of big data analytics as well as artificial intelligence for healthcare. While there are some studies that study that importance of data analytics in few areas of healthcare, no other study puts emphasis on application of big data analytics and artificial intelligence in the fields of healthcare management. This article is also novel in studying the current state of application of big data analytic and artificial intelligence in the healthcare management and patient care. The article clearly articulates how the development of big data analytics has been over the past few years and how it improves management of healthcare. It also alludes to the further areas of research for future studies.

## ACKNOWLEDGEMENTS

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