
**Teesside University MIDDLESBROUGH TS1 3BA**
School of Computing – MSc Data Science

# SYSTEMATIC LITERATURE REVIEW AND REPORT

Research Methods, CIS 4011-N

## Big Data Analytics for Medical Imaging in Healthcare Sector

**Author: ATHIRA REGHUNATH**

**Student ID:** W9561613

**Module Leader:** Dr. Zia Ush Shamszaman

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## INTRODUCTION

In recent years, one of the hottest topics of scientific discussion has been big data. An industry analyst sought to define big data in the early 2000s using the three Vs: volume, velocity, and variability. With new technologies like Hadoop, it is now possible to store and use massive amounts of data that arrive at an unparalleled rate. This data is highly varied because it might be in a various format, including text documents, voice or video recordings, and financial transactions. Science, sports, advertising, health care, genomic sequence data, and medical imaging have all proven to benefit from big data analytics. This research provides a high-level overview of big data analytics in medical imaging. Medical imaging data from X-rays, CT scans, and MRIs, among other sources, can be handled effectively and efficiently using Big Data analytics platforms to acquire superior diagnostic insights.

## RESEARCH QUESTION

How Big Data Analytics works for Medical Imaging in Healthcare Sector?

## KEY CONCEPTS

Big Data Analytics
Big Data Analytics in Healthcare
Big Data Analytics in Medical Imaging
Medical Image Processing

## DATABASE RESEARCH

For my research, I used these three databases to find results and information. To get more accurate results and progress in learning, I found some more databases to add to the literature review.

1) ACM Library
2) IEEE Xplore
3) Discovery

### Database 1: ACM Library

| Question | Keywords | Filters | Results | Notes |
|---|---|---|---|---|
| What Published on Big Data Analytics? | "Big Data Analytics" | None | 559,912 | There are too many search results and it will take time to find the best results. As a result, I need to narrow my search to the last 7 years. |

| | | | | |
|---|---|---|---|---|
| What Published on Big Data Analytics in the previous 7 years? | "Big Data Analytics" | Year: 2015-2022 | 211,564 | It lowers the number of results, but still it's too much to read and find the answer. So, need to apply the keyword 'Medical Imaging' |
| What Published on 'Big Data Analytics' and 'Medical Imaging'? | "Big Data Analytics" and "Medical Imaging" | Year: 2015-2022 | 86,488 | There are too many results, including all the relative data. So, I need to add the keyword "Big Data Analytics" and title: "Medical Imaging" |
| What Published on 'Big Data Analytics' and the Document Title as 'Medical Imaging'? | "Big Data Analytics" and Title: as "Medical Imaging" | Year: 2015-2022 | 5,412 | Add keywords Title: as "Big Data Analytics" AND Title: as "Medical Imaging" |
| What Published on the Document Title as 'Big Data Analytics' and the Document Title as 'Medical Imaging'? | Title: as "Big Data Analytics" and Title: as "Medical Imaging" | Year: 2015-2022 | 533 | Still need to lower the results by adding the filter Year: 2020-2022 |
| What Published on the Document Title as 'Big Data Analytics' and the Document Title as 'Medical Imaging' in the past 2 years? | Title: as "Big Data Analytics" and Title: as "Medical Imaging" | Year: 2020-2022 | 232 | Need to minimise the number of results again, so we filter them again using the publication type of journal only. |
| What are the Journals Published on the Document Title as 'Big Data Analytics' and the Document Title as 'Medical Imaging' in the past 2 years? | Title: as "Big Data Analytics" and Title: as "Medical Imaging" | Year: 2020-2022<br><br>Publication: Journals | 38 | Got 38 journals but the required results are published by the IEEE Computer Society Press. So, we have to filter it also. |
| How Big Data Analytics works for Medical Imaging in Healthcare sector? | Title as "Big Data Analytics" and Title as "Medical Imaging" | Year: 2020-2022<br><br>Publication: Journals<br><br>Publisher: IEEE Computer Society Press | 9 | Now got the 9 journals for my research from this particular database. |

## Database 2: IEEE Xplore

| Question | Keyword | Filter | Results | Notes |
|---|---|---|---|---|
| What Published on Big Data Analytics? | "Big Data Analytics" | None | 8,278 | Too many irrelevant results are showing. Need to filter it with past 7 years for better results. |
| What Published on Big Data Analytics in the previous 7 years? | "Big Data Analytics" | Year: 2015-2022 | 7535 | Results are still more than expected and change the keyword as 'Big Data Analytics for Medical Imaging' |
| What Published on Big Data Analytics for Medical Imaging in the previous 7 years? | "Big Data Analytics for Medical Imaging" | Year: 2015-2022 | 227 | Results are comparatively less but need to apply the filter for accurate results Year: 2020-2022 |
| What Published on Big Data Analytics for Medical Imaging in the previous 2 years? | "Big data Analytics for Medical Imaging" | Year: 2020-2022 | 67 | Select only conferences for better filtering |
| What all are the conference Paper published on Big data Analytics for Medical Imaging? | "Big data Analytics for Medical Imaging" | Year: 2020-2022<br><br>Only Conferences | 50 | Add Keyword Big Data Analytics as Document Title and Medical Imaging as All Metadata for perfect results |
| What all are the conference Paper (with "Document Title": big data analytics AND "All Metadata": medical imaging) published on Big data Analytics for Medical Imaging? | "Big data Analytics for Medical Imaging"<br><br>("Document Title": big data analytics) AND ("All Metadata": medical imaging) | Year: 2020-2022<br><br>Only Conferences | 38 | Then the result is showing the data from 2014-2021 we have to filter again it from 2018-2021 |
| How Big Data Analytics works for Medical Imaging in Healthcare sector? | ("Document Title": big data analytics) AND ("All Metadata": medical imaging) | Year: 2018-2021<br><br>Only Conferences | 11 | Got 11 Conference Papers for the research |

## Database 3: Discovery

| Question | Keyword | Filter | Results | Notes |
|---|---|---|---|---|
| What Published on Big Data Analytics? | "Big Data Analytics" | None | 41,298 | So many articles from different industries related to Big Data Analytics. Need to filter it with past 7 years. |
| What Published on Big Data Analytics in the past 7 years? | "Big Data Analytics" | Year: 2015-2022 | 32,331 | Need to add a proper keyword for filter as 'Big Data Analytics for Medical Imaging'. |
| What Published on Big Data Analytics for Medical Imaging in the past 7 years? | "Big Data Analytics for Medical Imaging" | Year: 2015-2022 | 527 | Need only past 5 years result. Add a filter for year |
| What Published on Big Data Analytics for Medical Imaging in the past 5 years? | "Big Data Analytics for Medical Imaging" | Past 5 Years | 393 | For better research only need to take Journal Articles and Conference Proceedings. |
| What are the Journal Articles & Conference Proceedings Published on Big Data Analytics for Medical Imaging in the past 5 years? | "Big Data Analytics for Medical Imaging" | Past 5 Years<br><br>Content Type: Journal Articles & Conference Proceedings | 372 | Add a keyword 'How Big Data Analytics works for Medical Imaging in Healthcare sector' |
| What Published on How Big Data Analytics works for Medical Imaging in Healthcare sector ? | "How Big Data Analytics works for Medical Imaging in Healthcare sector" | Past 5 Years<br><br>Content Type: Journal Articles & Conference Proceedings | 10 | Got 10 articles for my research |

## LITERATURE EVALUATION

When evaluating the whole research, so many filtering and keyword applications are done for better results. When we search without any filter, we get a huge number of results that contain irrelevant data from different sectors. For my research, I selected four databases primarily, but the fourth one was not showing the full research paper, so I removed that one and did research with ACM, IEEE Explorer, and Discovery. Among three of these, I got more relevant articles from IEEE. And it feels like conference papers are more than just articles. It is a little bit difficult to sort out the focused topics and make research among them. But the process is systematic and, through this, our research becomes much easier to complete.

From this research, we can evaluate that disease surveillance can benefit from the use of big data analytics. Medical imaging data sets can be evaluated quickly to produce more precise disease diagnoses and the necessary prevention and treatment strategies, leading in better crucial decision-making. Medical photos come in a variety of sizes, resolutions, and modalities. To handle this massive volume of image data, a specialized analytics platform is necessary.

These images reveal the inner workings of the body, which is useful for detecting malignancies, diabetic retinopathy, and artery stenosis, among other things. The use of Big Data Analytics platforms to store, retrieve, and analyse medical picture data has resulted in considerably faster diagnosis and treatment planning. Parallel programming and cloud computing have also aided in overcoming the difficulties of processing such large amounts of data. Images are retrieved and patterns are detected using the extracted data during medical image processing. Hadoop, MapReduce, YARN, Spark, Hive, and other tools and frameworks are utilised to solve the problem. Machine learning and deep learning techniques are commonly used to accomplish the required analytics. Several strategies are employed, including genetic algorithms and association rules.

## INCLUSION AND EXCLUSION PROCESS

| Sl No | Research Paper Title | Included/ Excluded | Reasons |
|---|---|---|---|
| 1 | "Data-Enabled Digestive Medicine: A New Big Data Analytics Platform (Lu Yan, Weihong Huang, Liming Wang, Song Feng, Yonghong Peng, and Jie Peng, May/June 2021)" | **Excluded** | Related to Big Data Analytics but not to Medical Imaging. |
| 2 | "A Latent Gaussian Copula Model for Mixed Data Analysis in Brain Imaging Genetics (Aiying Zhang,Jian Fang,Wenxing Hu,Vince D. Calhoun,Yu-Ping Wang, July-Aug. 2021)" | **Included** | This paper gives more information about Big Data Analytics in Brain Imaging |
| 3 | "Group Sparse Joint Non-Negative Matrix Factorization on Orthogonal Subspace for Multi-Modal Imaging Genetics Data Analysis (Peng Peng , Yipu Zhang , Yongfeng Ju , Kaiming Wang, Gang Li, Vince D. Calhoun, and Yu-Ping Wang, Jan.-Feb. 2022)" | **Excluded** | Not fully related to my topic |
| 4 | "A Data-Driven Approach to Predict and Classify Epileptic Seizures from Brain-Wide Calcium Imaging Video Data (Jingyi Zheng,Fushing Hsieh,Linqiang Ge, Nov.-Dec. 2020)" | **Included** | Related to the selected topic |
| 5 | "Integration of Imaging (epi)Genomics Data for the Study of Schizophrenia Using Group Sparse Joint Nonnegative Matrix Factorization (Min Wang,Ting-Zhu Huang,Jian Fang,Vince D. Calhoun,Yu-Ping Wang, Sept.-Oct. 2020)" | **Excluded** | Not related to Big Data Analytics but related to Healthcare sector |
| 6 | "Identify Consistent Cross-Modality Imaging Genetic Patterns via Discriminant Sparse Canonical Correlation Analysis (Meiling Wang,Wei Shao,Xiaoke Hao,Li Shen,Daoqiang Zhang, July-Aug. 2021)" | **Excluded** | Not gives any information related to Big Data Analytics |

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|---|---|---|---|
| 7 | "Multi-Task Sparse Canonical Correlation Analysis with Application to Multi-Modal Brain Imaging Genetics (Lei Du, Kefei Liu, Xiaohui Yao, Shannon L. Risacher, Junwei Han, Andrew J. Saykin, Lei Guo, Li Shen, Jan.-Feb. 2021)" | **Included** | Some areas give some information about medical imaging |
| 8 | "A Novel Encoding and Decoding Calibration Guiding Pathway for Pathological Image Analysis (Hansheng Li,JianPing Li,Yuxin Kang,Chunbao Wang,Feihong Liu,Wenli Hui,Qirong Bo,Lei Cui,Jun Feng,Lin Yang, Jan.-Feb. 2022)" | **Excluded** | Paper is not related to big data analytics or medical imaging |
| 9 | "Celiac Disease Detection From Video capsule Endoscopy Images Using Strip Principal Component Analysis (Bing Nan Li,Xinle Wang,Rong Wang,Teng Zhou,Rongke Gao,Edward J. Ciaccio,Peter H. Green, July-Aug. 2021)" | **Excluded** | Not gives any information related to Big Data Analytics |
| 10 | "Using Big Data Analytics to Detect Fraud in Healthcare Provision (Spiros V. Georgakopoulos;Parisis Gallos;Vassilis P. Plagianakos, 2020)" | **Excluded** | Content of this paper is related to healthcare sector but not about the Medical Imaging |
| 11 | "Segmentation and Classification of Brain MR Images Using Big Data Analytics (Mahboob Alam;Mohd Amjad, 2018)" | **Included** | This paper gives information about the Brain MRI using Big Data Analytics |
| 12 | "Big Data Analytics of Inpatients Flow with Diabetes Mellitus type 1: Revealing new awareness with Advanced Visualization of Medical Information System Data (Olga Kolesnichenko; Elena Marochkina;Roman Komarov;Lev Mazelis; 2019)" | **Excluded** | It's only talks about diabetic mellitus |
| 13 | "Health Analytics on Big COVID-19 Data (Nguyen Duy Thong Tran;Carson K. Leung;Daryl L.X. Fung;Thanh Huy Daniel Mai, 2021)" | **Excluded** | Not related to the subject. It's only talking about the covid 19 data |
| 14 | "An Intelligent Visual Big Data Analytics Framework for Supporting Interactive Exploration and Visualization of Big OLAP Cubes (Carlos Ordonez;Zhibo Chen;Alfredo Cuzzocrea;Javier Garcia-Garcia, 2020)" | **Excluded** | This paper is not related to healthcare industry. |
| 15 | "The Use of Big Data Analytics in Medical Images: a Survey (Mohammed Shatnawi;Muneer Bani Yassein;Ibtihal Jalabneh, 2020)" | **Included** | It's very much related to the topic Big Data Analytics for Medical Imaging |
| 16 | "Big Data Analytics in Healthcare (M. Ambigavathi;D. Sridharan, 2018)" | **Included** | Medical Imaging is a small part of this paper |
| 17 | "Big Data Analytics in Healthcare: Design and Implementation for a Hearing Aid Case Study (Jeppe Høy Christensen; Michael Kai Petersen; Niels Henrik Pontoppidan Eriksholm Research | **Excluded** | Not related to medical imaging |

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|---|---|---|---|
| | Centre, Snekkersten, Denmark; Marco Cremonini. 2018)" | | |
| 18 | "Using Big Data Analytics to Create a Predictive Model for Joint Strike Fighter (Ryan Norman;Jason Bolin;Edward T. Powell;Sanket Amin;John Nacker, 2018)" | **Excluded** | Not the area related to the topic |
| 19 | "Big Data Analysis and Services: Visualization on Smart Data to Support Healthcare Analytics (Carson K. Leung;Yibin Zhang;Calvin S.H. Hoi;Joglas Souza;Bryan H. Wodi, 2019)" | **Excluded** | Not a paper is talking about medical imaging |
| 20 | "Big Data Analytics APIs Architecture for Formative Assessors (Wassim Mahfouz;Heinz-Dietrich Wuttke, 2021)" | **Excluded** | This paper is not about medical industry |
| 21 | **"Editorial for Special Issue of Journal of Big Data Research on "Big Medical/Healthcare Data Analytics" (Sakr, Sherif. 2018)"** | **Included** | Topic is the part of this paper |
| 22 | "Big Healthcare Data Analytics in Internet of Medical Things (Allen, Margaret, 2020)" | **Excluded** | Related to medical field but not to medical imaging |
| 23 | **"Big data analytics in medical engineering and healthcare: methods, advances and challenges (Wang, Lidong. 2020)"** | **Included** | In this article topic is included and it's useful |
| 24 | **"Cognitive Internet of Medical Things, Big Healthcare Data Analytics, and Artificial intelligence-based Diagnostic Algorithms during the COVID-19 Pandemic (Morrison, Michael; Lăzăroiu, George. (2021)"** | **Excluded** | Not a relevant paper for my research area |
| 25 | **"Smart Biomedical Sensors, Big Healthcare Data Analytics, and Virtual Care Technologies in Monitoring, Detection, and Prevention of COVID-19 (Morris, Kevin. 2021)"** | **Excluded** | Not particularly speaks medical imaging |
| 26 | **"BIG DATA ANALYTICS CAPABILITIES, THE BUSINESS VALUE OF INFORMATION TECHNOLOGY, AND HEALTHCARE ORGANIZATIONS: THE NEED FOR CONSENSUS IN EVIDENCE-BASED MEDICAL PRACTICES (Coatney, Karen. 2018)"** | **Excluded** | Not related to medical field |
| 27 | "SNOMED CT-Based Standardized e-Clinical Pathways for Enabling Big Data Analytics in Healthcare (Ayman D. Alahmar, Rachid Benlamri. 2020)" | **Included** | This paper is useful in terms of medical imaging |
| 28 | "Deep Learning and Big Data in Healthcare: A Double Review for Critical Beginners (Luis Bote-Curiel, Sergio Muñoz-Romero, Alicia Gerrero-Curieses, José Luis Rojo-Álvarez. 2019)" | **Included** | Some areas speak about the topic. |

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|---|---|---|---|
| 29 | "Visualization for Quality Healthcare: Patient Flow Exploration (Veronika Domova; Shiva Sander-Tavallaey. 2019)" | **Excluded** | Not a relevant document for my studies |
| 30 | "Influential Usage of Big Data and Artificial Intelligence in Healthcare (Yan Cheng Yang, Saad Ul Islam, Asra Noor, Sadia Khan, Waseem Afsar, Shah Nazir. 2021)" | **Excluded** | Not about the specific topic. Only related to Big Data |

**Total Included** = 10
**Total Excluded** = 20

## LIMITATIONS

The major limitation of this topic is the lack of relevant papers related to this particular topic. We will get so many results for the healthcare industry and data science field. But it is so difficult to find a paper about medical imaging with data analytics. Another limitation is the restrictions on choosing only research papers and articles. So much relevant information is in other types of publications. Another significant limitation was that the information technology industry is expanding and technologies are changing all the time. need to filter the results within 5 years. A major limitation is the shortage of papers related to the specific topic.

## CONCLUSION

So many industries are widely using big data analytics. However, the clinical, medical imaging, and ECG sectors are still in the early stages of adopting big data, and research in these fields is still limited. Using proper analytics, we can extract more valuable information from the healthcare data generated by organizations. Hadoop can be used to generate meaningful real-time analytics for predictions on emergencies or assist in planning, strategizing, and making decisions. This research mainly spotlights the potential of big data analytics in the healthcare industry. specifically, for medical imaging. The purpose of this paper was to discuss the importance of big data analytics in medicine, medical imaging, and ECG, highlighting how they can improve the ECG field. From this research, we can conclude that big data analysis can play a major role in the healthcare industry particularly in medical image processing.

## REFERENCES


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- "A Latent Gaussian Copula Model for Mixed Data Analysis in Brain Imaging Genetics (Aiying Zhang,Jian Fang,Wenxing Hu,Vince D. Calhoun,Yu-Ping Wang, July-Aug. 2021)"
- "Group Sparse Joint Non-Negative Matrix Factorization on Orthogonal Subspace for Multi-Modal Imaging Genetics Data Analysis (Peng Peng , Yipu Zhang , Yongfeng Ju , Kaiming Wang, Gang Li,Vince D. Calhoun, and Yu-Ping Wang, Jan.-Feb. 2022)"
- "A Data-Driven Approach to Predict and Classify Epileptic Seizures from Brain-Wide Calcium Imaging Video Data (Jingyi Zheng,Fushing Hsieh,Linqiang Ge, Nov.-Dec. 2020)"
- "Integration of Imaging (epi)Genomics Data for the Study of Schizophrenia Using Group Sparse Joint Nonnegative Matrix Factorization (Min Wang,Ting-Zhu Huang,Jian Fang,Vince D.

Calhoun,Yu-Ping Wang, Sept.-Oct. 2020)"

- "Identify Consistent Cross-Modality Imaging Genetic Patterns via Discriminant Sparse Canonical Correlation Analysis (Meiling Wang,Wei Shao,Xiaoke Hao,Li Shen,Daoqiang Zhang, July-Aug. 2021)"
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- "Celiac Disease Detection From Video capsule Endoscopy Images Using Strip Principal Component Analysis (Bing Nan Li,Xinle Wang,Rong Wang,Teng Zhou,Rongke Gao,Edward J. Ciaccio,Peter H. Green, July-Aug. 2021)"
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- "Health Analytics on Big COVID-19 Data (Nguyen Duy Thong Tran;Carson K. Leung;Daryl L.X. Fung;Thanh Huy Daniel Mai, 2021)"
- "An Intelligent Visual Big Data Analytics Framework for Supporting Interactive Exploration and Visualization of Big OLAP Cubes (Carlos Ordonez;Zhibo Chen;Alfredo Cuzzocrea;Javier Garcia-Garcia, 2020)"
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- "Big Data Analytics APIs Architecture for Formative Assessors (Wassim Mahfouz;Heinz-Dietrich Wuttke, 2021)"
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- "Big Healthcare Data Analytics in Internet of Medical Things (Allen, Margaret, 2020)"
- "Big data analytics in medical engineering and healthcare: methods, advances and challenges (Wang, Lidong. 2020)"
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- “SNOMED CT-Based Standardized e-Clinical Pathways for Enabling Big Data Analytics in Healthcare (Ayman D. Alahmar, Rachid Benlamri. 2020)”
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- “Radiogenomics for Precision Medicine With a Big Data Analytics Perspective (Andreas S. Panayides; MariosS.Pattichis;Stephanos Leandrou;Costas Pitris;Anastasia Constantinidou;Constantinos S. Pattichis. 2019)”