Web Application to Store and Analyze Data on the Cost of Healthcare

Rivu Bhattacharjee
ID: 1910626
Section: 02

Sarara Akbar
ID: 2020113
Section: 01

Abu Ahmed Rafi
ID: 1910001
Section: 02

Khatune Jannat Orpa
ID: 2222526
Section: 01

Safwan Sulaiman Sadi
ID: 2030310
Section: 02

Tausif Ertiza Sameer
ID: 2120357
Section: 05

December 17, 2023

***Abstract* - A web application that stores and analyzes data on the cost of healthcare can be a valuable tool for healthcare providers, insurance companies, and patients alike. Such an application can help identify trends in healthcare costs, allowing providers to adjust their pricing models and insurance companies to offer more competitive rates. Patients could use the application to compare the cost of different treatments and procedures, making it easier to find affordable healthcare options. This solution can generate longitudinal patient records across stored data in near real-time to help patients cut costs.**

***Keywords* - Web application, cost of healthcare, valuable tool, compare, pricing models.**

1 Introduction

Creating a robust web application to store and analyze healthcare cost data is a pivotal step toward enhancing healthcare efficiency and reducing overall costs. This powerful tool aims to serve healthcare providers, researchers, and policymakers by collecting and securely storing data from diverse sources such as insurance companies, hospitals, clinics, and government agencies. The data, once collected, undergoes meticulous analysis, enabling users to identify trends and patterns that can inform strategic decisions.

The application facilitates easy comparison of medical procedure costs, medicine prices, and insurance policies from various healthcare providers. By offering a user-friendly interface and comprehensive data visualization, the tool empowers users to recognize affordable healthcare options quickly. The overarching goal is to pinpoint areas where costs can be minimized, whether by avoiding unnecessary tests or procedures, or by selecting more cost-effective medication or treatment alternatives.

Throughout the development process, emphasis is placed on data security, compliance with privacy regulations, and the adoption of scalable and modern technologies. The application's backend processes are executed through a secure server, while the frontend is designed for intuitive interaction, utilizing frameworks like React or Angular. Robust user authentication, authorization mechanisms, and encryption protocols are implemented to safeguard sensitive healthcare data.

The incorporation of data analysis tools, such as Pandas for Python or D3.js for visualization, ensures that users can glean valuable insights from the collected data. Thorough testing, deployment on reliable cloud platforms, and continuous monitoring contribute to the application's reliability. Ongoing maintenance and updates, coupled with user training and support, ensure the sustained effectiveness of this healthcare cost analysis tool. Ultimately, the application strives to be a catalyst

2 Literature Review

Rivu Bhattacharjee

2.1 Paper 1: Requirements Engineering Using Mockups and Prototyping Tools: Developing a Healthcare Web-Application

Journal/Conference Rank: N/A (Conference paper)
Publication Year: 2014
Reference: [1]

2.1.1 Summary

This paper discusses the challenges faced by healthcare web-application development teams and offers effective solutions to overcome them. The authors propose the use of mockups and prototyping tools to support the requirements engineering process. The paper is divided into several sections, each of which is summarized below. The introduction provides an overview of the challenges faced by healthcare web-application development teams. The authors argue that the complexity of healthcare systems, the need for interoperability, and the involvement of multiple stakeholders make it difficult to develop effective healthcare web-applications. The authors propose the use of mockups and prototyping tools to support the requirements engineering process. The background section provides an overview of the requirements engineering process and the challenges faced by healthcare web-application development teams. The authors argue that traditional requirements engineering methods are not effective in the healthcare domain due to the complexity of healthcare systems and the involvement of multiple stakeholders. The methodology section describes the rapid prototyping model used in this study. The authors used Lumzy, a web-based prototyping tool, to develop a prototype of a healthcare web-application. The prototype was developed in three phases: requirements elicitation, prototype development, and prototype validation and reformulation. The results section describes the outcomes of the rapid prototyping model used in this study. The authors found that the use of mockups and prototyping tools was effective in supporting the requirements engineering process. The prototype developed in this study was able to meet the needs of the stakeholders and was well-received by the users. The discussion section provides a critical analysis of the results of the study. The authors argue that the use of mockups and prototyping tools can help to overcome the challenges faced by healthcare web-application development teams. The authors also discuss the limitations of the study and suggest areas for future research. The conclusion summarizes the main findings of the study and highlights the importance of using mockups and prototyping tools in the requirements engineering process for healthcare web-applications. The authors argue that the use of these tools can help to overcome the challenges faced by healthcare web-application development teams and can lead to the development of more effective healthcare web-applications.

2.1.2 Software Architecture

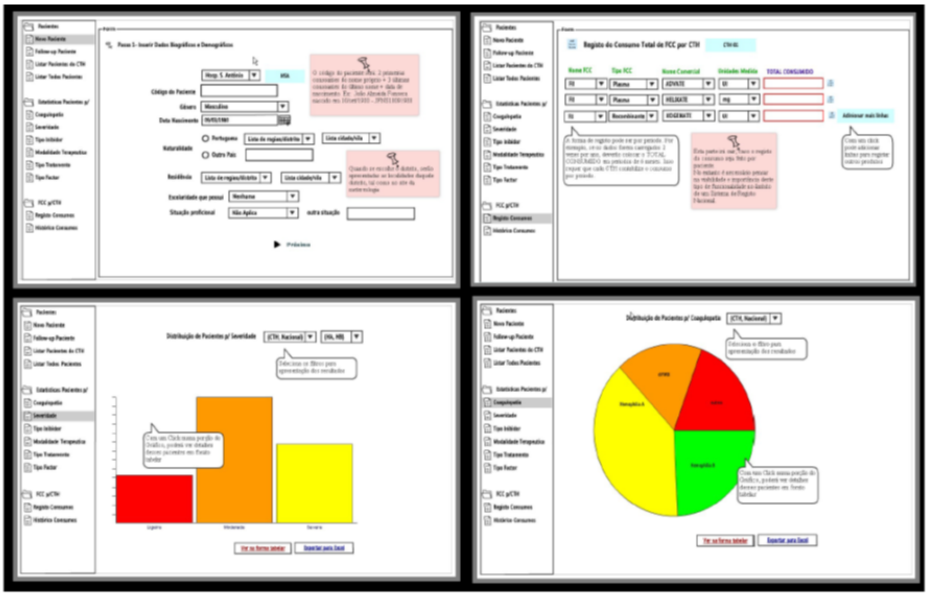


Fig. 2. First version of the *prototype-hemo@record*: same examples of mockups (in Portuguese)

Figure 1: Software architecture diagram for Paper 1.

2.1.3 Data Parameters

N/A

2.1.4 Datasets Used

N/A

2.1.5 Paper Link

Access the full paper at https://link.springer.com/chapter/10.1007/978-3-319-07731-4$_6$4.

2.2 Paper 2: Social Networks and Web-Based Applications in the Healthcare Sector

Journal/Conference Rank: N/A
Publication Year: 2016
Reference: [2]

2.2.1 Summary

This paper explores the potential benefits of web-enabled information technologies and social networks in the healthcare sector. The authors argue that these technologies can improve healthcare access and quality while lowering costs. They also discuss the potential value of social networks for healthcare organizations, including the opportunity to interact with patients and leverage real-world data sets for new treatments and care pathways. The paper begins by discussing the rapid growth of web-enabled healthcare delivery. Patients are increasingly using online support communities to share their experiences and search for medical information, while healthcare professionals are using these technologies to access the latest information in their field, consult with colleagues, and communicate with patients. The authors argue that these technologies can help improve healthcare access and quality, particularly for underserved populations. The paper then explores the potential value of social networks for healthcare organizations. Social networks can provide a platform for patients to interact with each other and with healthcare professionals, which can help improve patient outcomes and satisfaction. Additionally, social networks can provide healthcare organizations with access to real-world data sets that can be used to develop new treatments and care pathways. The authors also discuss the benefits of web-enabled information technologies for healthcare organizations. These technologies can help streamline processes and reduce costs, while also improving patient outcomes. For example, web-based applications can be used to manage patient records, schedule appointments, and provide remote consultations. The authors note that ensuring the security and privacy of sensitive information is critical to creating public trust in these technologies. Overall, the paper argues that web-enabled information technologies and social networks have the potential to transform the healthcare sector. These technologies can help improve healthcare access and quality, while also lowering costs and improving patient outcomes. However, the authors note that there are also challenges associated with these technologies, particularly around data privacy and security. They argue that healthcare organizations must work to address these challenges in order to fully realize the potential benefits of these technologies.

2.2.2 Software Architecture

N/A

2.2.3 Data Parameters

N/A

2.2.4 Datasets Used

N/A

2.2.5 Paper Link

Access the full paper at https://link.springer.com/chapter/10.1007/978-3-319-23341-3$_1$1.

2.3 Paper 3: Native Apps versus Web Apps Which Is Best for Healthcare Applications?

Journal/Conference Rank: A
Publication Year: 2013
Reference: [3]

2.3.1 Summary

This paper compares the use of Native Apps and Web Apps for healthcare applications, using an In Vitro Fertilisation (IVF) treatment stress study App as an example. The study aims to examine the psychosocial factors that influence distress levels in patients throughout the duration of one cycle of IVF treatment. The study uses a number of questionnaires which ask patients to report their health status in relation to their infertility and its treatment. Patients need to be signalled to complete the questionnaire at different time points throughout the treatment process. To support this, a Smartphone application (IVF App) has been designed so that, at each selected time point, the patient receives a reminder to complete the set of questionnaires. One of the questionnaires has different questions presented on different days. Each time they complete the questionnaires, response data is sent to a server for analysis. The paper discusses the benefits and drawbacks of Native Apps and Web Apps for healthcare applications. Native Apps are designed specifically for a particular platform, such as iOS or Android, and are downloaded and installed on a user's device. Web Apps, on the other hand, are accessed through a web browser and do not need to be downloaded or installed. The paper argues that Native Apps have several advantages over Web Apps, including better performance, better user experience, and access to device-specific features such as the camera and GPS. However, Native Apps are more expensive to develop and maintain, and require users to download and install them. The paper also discusses the use of Ecological Momentary Assessment (EMA) in the IVF App study. EMA is a methodology that involves collecting data in real-time, in the participant's natural environment. In the IVF App study, patients are signalled every two days at varying time points. The facility to vary the time points of patient signalling confers an advantage in that certain moods may become entrained to particular routines and times of day and thus impact upon the levels of distress that are subsequently reported. A further advantage of a flexible signalling facility over and above the use of paper-based methods is that the response delay (i.e. the time it takes to respond to the signal and complete the task) may also provide an indirect measure of response reliability. In conclusion, the paper argues that Native Apps are better suited for healthcare applications than Web Apps, due to their better performance and user experience. The paper also highlights the benefits of using EMA in healthcare studies, and the advantages of using smartphone applications for healthcare delivery.

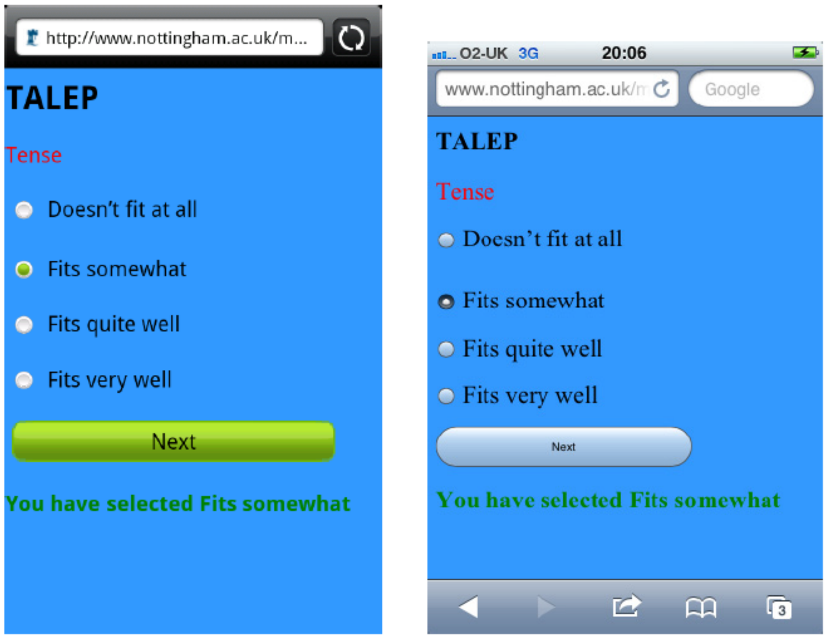


Fig. 1. Screenshots of IVF Web App implementation on Android and iPhone

Figure 2: Software architecture diagram for Paper 1.

2.3.2 Software Architecture

2.3.3 Data Parameters

The paper does not explicitly mention any data parameters used in the study. However, it does mention that response data from the questionnaires completed by patients using the IVF App is sent to a server for analysis. It is likely that this response data is used to analyze the psychosocial factors that influence distress levels in patients throughout the duration of one cycle of IVF treatment, as stated in the study's aim. However, the paper does not provide any further details on the specific data parameters or analysis methods used.

2.3.4 Datasets Used

N/A

2.3.5 Paper Link

Access the full paper at https://link.springer.com/chapter/10.1007/978-3-642-39262-7$_2$2.

2.4 Paper 4: An Intelligent Web-Based Healthcare System: The Case of DYMOS

Journal/Conference Rank: N/A (Book chapter)
Publication Year: 2010
Reference: [4]

2.4.1 Summary

This paper discusses an intelligent web-based healthcare system called DYMOS, which aims to address the weaknesses in the eHealth sector and promote effective collaboration among healthcare professionals. The paper begins by providing an overview of the eHealth sector and the challenges it faces, such as the lack of interoperability and the fragmentation of healthcare services. The authors argue that these challenges can be addressed through the use of virtual communities and collaboration tools. The paper then introduces the DYMOS system, which is designed to provide a comprehensive solution to the challenges faced by the eHealth sector. The system is based on a set of original assumptions, which include the use of intelligent agents, the integration of various healthcare services, and the provision of personalized healthcare services. The authors argue that these assumptions are necessary to promote effective collaboration among healthcare professionals and to improve the quality of healthcare services. The paper then describes the architecture of the DYMOS system, which consists of several modules, including the intelligent agent module, the healthcare service module, and the collaboration module. The intelligent agent module is responsible for providing personalized healthcare services to patients, while the healthcare service module is responsible for integrating various healthcare services. The collaboration module is responsible for promoting effective collaboration among healthcare professionals through the use of virtual communities and collaboration tools. The paper then describes the evaluation methodology used to evaluate the DYMOS system. The evaluation was conducted in a real hospital environment, and the results showed that the system was efficient and effective in providing personalized healthcare services and promoting effective collaboration among healthcare professionals. The authors argue that the DYMOS system can be used as a model for other eHealth systems, as it provides a comprehensive solution to the challenges faced by the eHealth sector. The paper concludes by summarizing the main points of the paper and highlighting the importance of collaboration and the use of intelligent agents in the eHealth sector. The authors argue that the DYMOS system provides a comprehensive solution to the challenges faced by the eHealth sector and can be used as a model for other eHealth systems. They also suggest that future research should focus on the development of more advanced intelligent agents and the integration of more healthcare services into the system. In summary, this paper provides a comprehensive analysis of the eHealth sector and the challenges it faces. It introduces an intelligent web-based healthcare system called DYMOS, which is designed to address the weaknesses in the eHealth sector and promote effective collaboration among healthcare professionals. The paper describes the architecture of the DYMOS system and the evaluation methodology used to evaluate the system. The results of the evaluation

2.4.2 Software Architecture

Describe the software architecture used in the paper.

2.4.3 Data Parameters

The paper does not mention any specific data parameters used in the development or evaluation of the DYMOS system. However, it does describe the evaluation methodology used to evaluate the system, which involved conducting trials in a real hospital environment. The evaluation methodology included a questionnaire that was used to gather

Figure 3: Software architecture diagram for Paper 1.

feedback from healthcare professionals on the system's features and usability. The paper also describes the positive evaluation results, which showed that the system was efficient and effective in providing personalized healthcare services and promoting effective collaboration among healthcare professionals.

2.4.4 Datasets Used

N/A

2.4.5 Paper Link

Access the full paper at https://link.springer.com/chapter/10.1007/978-1-4419-1274-9$_3$.

2.5 Paper 5: Architecture and Design of a Patient-Friendly eHealth Web Application: Patient Information Leaflets and Supplementary Services

Journal/Conference Rank: A
Publication Year: 2012
Reference: [5]

2.5.1 Summary

This paper by Dehling et al. presents a patient-friendly eHealth web application that provides information on pharmaceuticals. The paper is divided into several sections, each of which highlights a different aspect of the web application. In the introduction, the authors discuss the importance of patient information leaflets and the potential benefits of a patient-friendly eHealth web application. They also introduce the architecture and design of the web application, which includes patient information leaflets and supplementary services. The second section of the paper discusses the architecture of the web application in more detail. The authors describe the use of an open-source framework to ensure reliability and scalability, as well as the use of a modular design to allow for customization and extensibility. The third section of the paper focuses on the patient information leaflets that are provided through the web application. The authors discuss the limitations of traditional patient information leaflets and describe how the web application addresses these limitations through the use of multimedia, interactivity, and personalization. The fourth section of the paper describes the supplementary services that are offered through the web application. These services include medication reminders, drug interaction checking, and personalized health recommendations. The fifth section of the paper discusses the potential benefits of the web application for patients, healthcare providers, and pharmaceutical companies. The authors argue that the web application can improve patient outcomes, reduce healthcare costs, and increase patient satisfaction. Overall, this paper presents a comprehensive overview of a patient-friendly eHealth web application that provides information on pharmaceuticals. The authors highlight the potential benefits of the web application and provide detailed descriptions of its architecture, design, and features.

2.5.2 Software Architecture

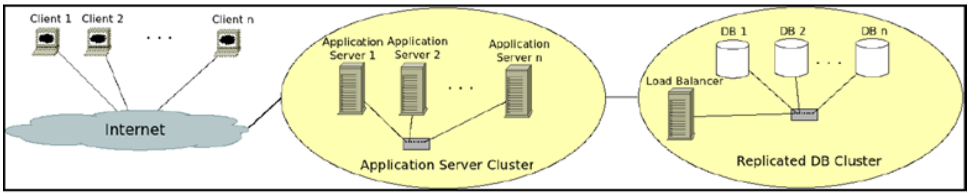


Figure 2. Physical Infrastructure

Figure 4: Software architecture diagram for Paper 5.

2.5.3 Data Parameters

2.5.4 Datasets Used

N/A

2.5.5 Paper Link

Access the full paper at https://papers.ssrn.com/sol3/papers.cfm?abstract$_{i}d = 2152925$.

2.6 Paper 6:A developed MEDICAL+ and MEDICAL PLUS+ for Tele patient care web applications

Journal/Conference Rank: Q1 (KeAi Publishing)
Publication Year: 2023
Reference: [6]

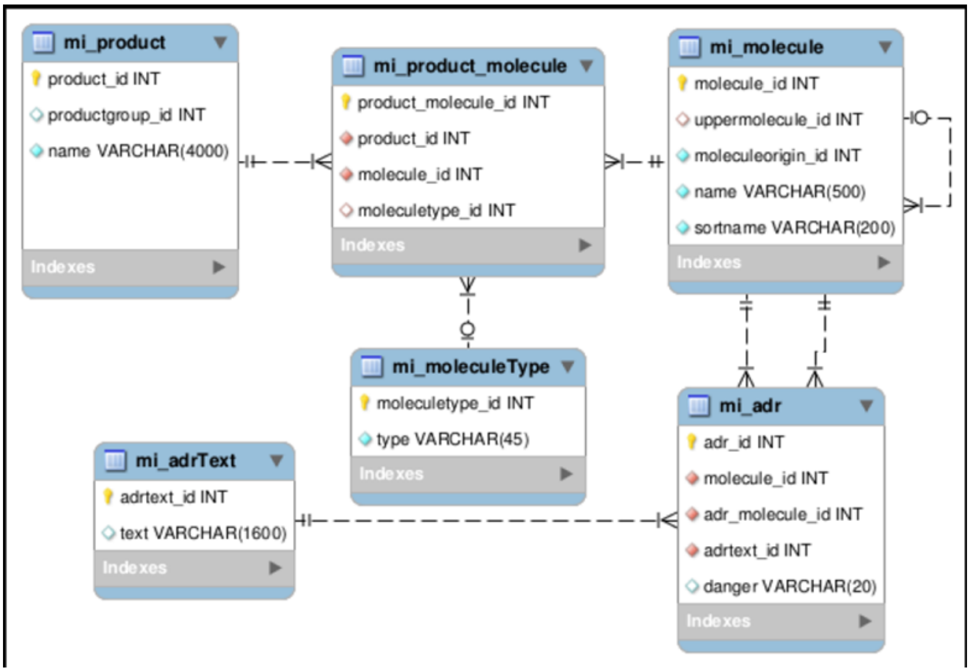


Figure 5: Software architecture diagram for Paper 5.

2.6.1 Summary

This paper proposes a Tele Patient care system that aims to provide a high-quality and reliable medical web application to create a safe, comfortable, practical, and appropriate healthcare environment for both medical personnel and patients. The paper is organized into six sections. Section 1 provides an introduction to the paper and highlights the importance of telemedicine in the current healthcare landscape. The authors discuss the challenges posed by the Covid-19 epidemic and the need for remote healthcare solutions. They also introduce the Tele Patient care system and its potential benefits. Section 2 provides background and related work, highlighting the challenges posed by the Covid-19 epidemic and the need for remote healthcare solutions. The authors review the literature on telemedicine and discuss the benefits and limitations of existing systems. They also discuss the importance of user-centered design and the need for a comprehensive evaluation of the Tele Patient care system. Section 3 reviews the waterfall methodology and the clinical trial application. The authors describe the process of developing the Tele Patient care system, including the design, implementation, and testing phases. They also discuss the importance of stakeholder engagement and the need for a multidisciplinary team. Section 4 illustrates the proposed system design, including the architecture, user interface, and features of the system. The authors describe how the system enables remote consultations, medical record management, and prescription management. They also discuss the importance of data security and privacy. Section 5 presents the results and discussion of the clinical trial. The authors report that the Tele Patient care system was well-received by patients and medical personnel and that it improved the quality of healthcare services. They also discuss the limitations of the study, including the small sample size and the need for further evaluation. Finally, Section 6 provides the paper's conclusion, summarizing the main findings and highlighting the potential of the Tele Patient care system to improve healthcare services and reduce costs. The authors also discuss the limitations of the study and suggest future research directions, including the need for a larger-scale evaluation and the integration of artificial intelligence and machine learning technologies. Overall, the paper provides a comprehensive overview of the Tele Patient care system and its potential benefits for healthcare services. The authors highlight the importance of user-centered design, stakeholder engagement, and comprehensive evaluation in the development of telemedicine systems. They also discuss the potential of artificial intelligence and machine learning technologies to further improve healthcare services.

2.6.2 Software Architecture

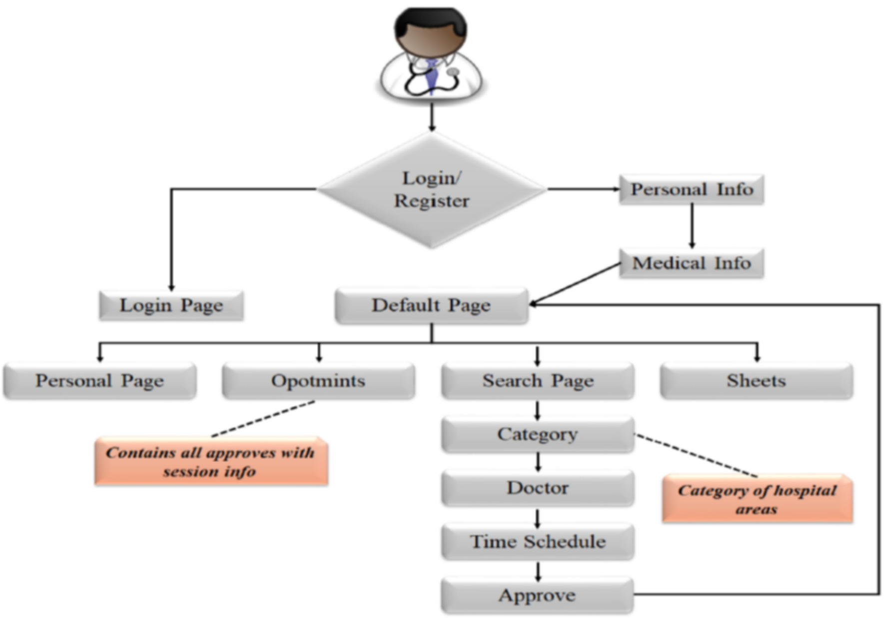


Figure 6: Software architecture diagram for Paper 5.

2.6.3 Data Parameters

N/A

2.6.4 Datasets Used

N/A

2.6.5 Paper Link

Access the full paper at https://www.sciencedirect.com/science/article/pii/S2588914123000217.
Member 2: Sarara Akbar

2.7 Paper 1: Big Data Challenges and Opportunities in Healthcare Informatics and Smart Hospitals

Journal/Conference Rank: Q2
Publication Year: 2019
Reference: [7]

2.7.1 Summary

The paper discusses the significant impact of big data and advanced technologies on healthcare informatics and smart hospitals. It highlights the following key points: Healthcare Informatics Revolution: The availability of low-cost wearable sensors has led to a revolution in healthcare informatics. Smart hospitals leverage Internet of Things (IoT) sensors to create Remote Patient Monitoring (RPM) models, a part of Ambient Assisted Living (AAL) applications. These models generate large volumes of patient data. Cloud-Based Architectures: To handle the massive amount of data generated by AALs, cloud-based architectures are adopted. These architectures facilitate the storage, processing, and analysis of big medical data. Cloud technologies offer hope for developing innovative medical services. Software Frameworks: Advanced software frameworks like Hadoop, Spark, and machine learning libraries are crucial for processing and analyzing big medical data. Hadoop allows the storage of data in its native form, not just in data warehouses, while Spark accelerates data analysis. Predictive Analytics: The paper discusses a case study on monitoring patients with chronic diseases, such as blood pressure disorders, using a cloud-based monitoring model. The model proves effective in predicting patients' health status, especially for the elderly living alone. The Era of Big Data: The paper emphasizes the exponential growth of data from various sources, including IoT sensors, RFID, social media, and more. This data presents the challenges of volume, velocity, variety, veracity, and privacy, making the optimal use of big data in healthcare informatics crucial. Potential Benefits: Big data is expected to contribute to innovative healthcare services, efficient budget utilization, better use of medical resources, and improved patient care. It will support evidence-based medicine, diagnosis, and clinical decision support. Hadoop in Healthcare: Hadoop technology addresses several challenges in healthcare informatics, including parallel data processing, safe storage, and fault tolerance.

2.7.2 Software Architecture

The paper highlights the use of cloud-based architectures, particularly Hadoop and Spark, to handle big medical data. Hadoop is described as an open-source framework for scalable, distributed, and reliable computing. It offers scalability, fault tolerance, and cost-effectiveness, making it suitable for healthcare applications. Hadoop's key components include Hadoop Common, Hadoop YARN, Hadoop Distributed File System (HDFS), and Hadoop MapReduce.(Fig 4) Hadoop Distributed File System (HDFS) is utilized for reliable storage and access to application data. Data is split into chunks, distributed among different nodes, and replicated for fault tolerance. The NameNode maintains metadata about data chunks and their locations. Hadoop MapReduce is a framework for processing large datasets in parallel across a cluster of commodity servers. It includes Mapper functions, Shuffle and Sort functions, and Reducer functions for data processing.

2.7.3 Data Parameters

The paper discusses the challenges related to big data in healthcare informatics, including the volume, velocity, variety, veracity, and privacy of patient data. The growth of electronic health records is highlighted, emphasizing the need for infrastructures capable of parallel processing, safe storage, and fault tolerance to manage the massive volume of data. Overall, the paper underscores the role of big data and advanced technologies in

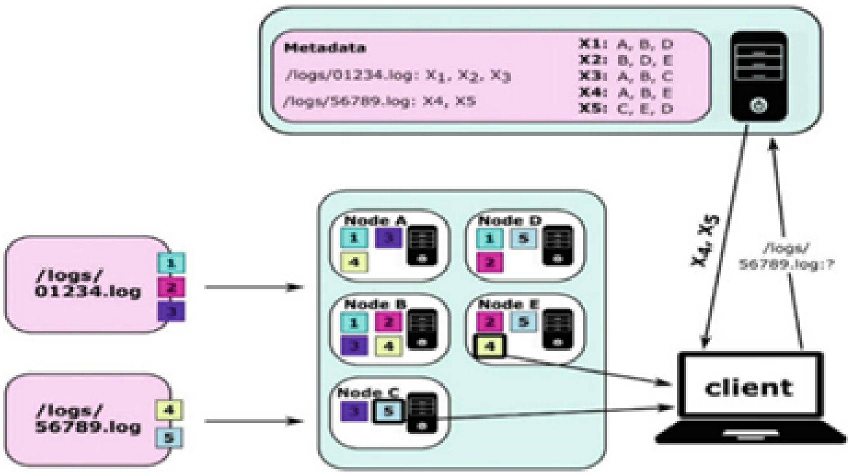


Figure 7: Software architecture diagram for Paper 1.

transforming healthcare informatics, with a focus on software architecture and the data challenges involved.

2.7.4 Datasets Used

he structure of the generated dataset is listed in Table 1. Table 2 as well as Figs. 1, 2 and 3 show statistics about the generated datasets for the three patients at 24 h (a sample every 15 min).

2.7.5 Paper Link

Access the full paper at https://link.springer.com/chapter/10.1007/978-3-030-01560-2_1.

2.8 Paper 2: Cloud Computing for Improved Healthcare:Techniques, Potential and Challenges

Journal/Conference Rank: N/A
Publication Year: 2013
Reference: [8]

2.8.1 Summary

The paper discusses the transformation of healthcare solutions through technology, particularly cloud computing. It emphasizes the shift from traditional healthcare methodologies to smarter healthcare clouds and focuses on the potential and challenges of integrating cloud-enabled healthcare systems. Software as a Service (SaaS) for healthcare is introduced as a solution to adapt to changing doctor and patient needs worldwide. The paper explores the benefits and challenges of cloud-based healthcare systems, various healthcare cloud models, and leading SaaS providers for healthcare practitioners. It also discusses the application of data mining techniques for extracting valuable information from healthcare big data stored in the cloud.

2.8.2 Software Architecture

The paper mentions the adoption of cloud computing as a paradigm shift from traditional desktop computing. It explains that software programs are stored on servers and accessed through the internet rather than running from individual computers. Healthcare clouds are described as extensive networks of interconnected computers and servers dedicated to meeting the healthcare industry's needs. These clouds allow healthcare services to be delivered to users, such as doctors and patients, over internet connections. Registered users can access hardware and software managed by third parties at remote locations, leading to a significant transformation in how information is stored and accessed.

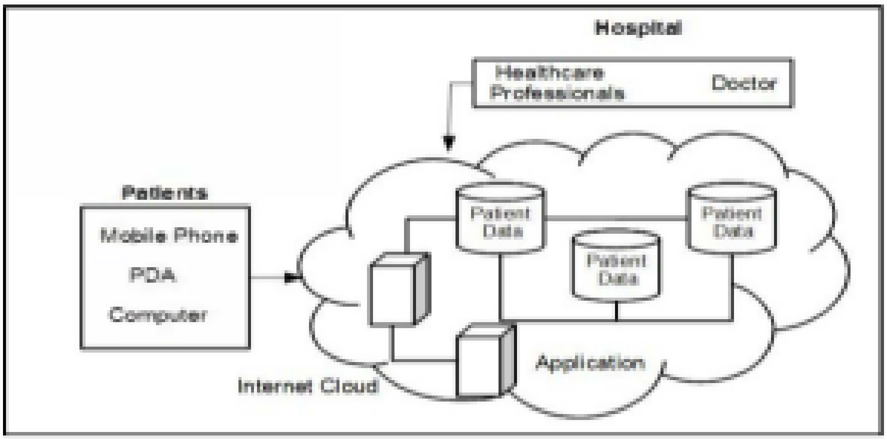


Figure 8: Software architecture diagram for Paper 2.

The paper also touches on the pay-as-you-go model of cloud computing, which enables organizations to pay only for the services and resources they consume, leading to enhanced agility and scalability.

2.8.3 Data Parameters

The paper addresses the concept of big data in the healthcare industry, with a focus on the vast volume of data generated from various sources. It mentions that healthcare applications have gained momentum through cellular networks and mobile technology, particularly in remote rural areas. The paper underscores the potential for healthcare clouds to make healthcare more efficient and cost-effective, despite security and privacy concerns. The internet cloud is introduced as a repository for medical data, emphasizing its impact on the management of healthcare records and the accessibility of e-health systems. The paper also discusses the application of data mining techniques to extract relevant information from the massive healthcare data saved in the cloud. It highlights the potential of big data mining to improve healthcare decision-making and mentions the challenges associated with managing and analyzing big healthcare data.

2.8.4 Datasets Used

The paper does not specify particular datasets used. It discusses concepts and technologies related to cloud-based healthcare systems, SaaS in healthcare, and data mining in the healthcare domain, but it does not reference specific datasets. If you are looking for healthcare datasets for research or analysis, you may need to refer to relevant healthcare data sources or repositories.

2.8.5 Paper Link

Access the full paper at https://ieeexplore.ieee.org/abstract/document/6707234.

2.9 Paper 3: Fog Computing for Smart Cities' Big Data Management and Analytics: A Review

Journal/Conference Rank: Q1
Publication Year: 2020
Reference: [9]

2.9.1 Summary

The paper discusses the challenges that modern cities face due to demographic growth, including ensuring a steady supply of essential services like water, electricity, transportation, healthcare, and safety. It highlights the role of sensing, communication, and digital technologies in addressing these challenges in the context of smart cities. One significant shift in smart cities is the move from traditional IT infrastructure to utility-supplied IT delivered over the Internet, allowing efficient management of the vast amounts of data generated by various city systems. The paper also explores the emerging paradigms of edge and fog computing and their potential to address data storage and analysis issues in smart cities.

2.9.2 Software Architecture

The paper primarily focuses on the concepts of edge and fog computing in the context of smart cities. While it provides a conceptual framework and discusses the benefits of these paradigms, it does not delve deeply into specific software architecture or implementation details.

2.9.3 Data Parameters

The paper emphasizes the importance of data management and analysis in smart cities. It discusses the challenges and solutions related to data generated by various smart city applications, including transportation, healthcare, and smart grids. The data parameters are not explicitly defined in the paper, but the focus is on handling massive volumes of data efficiently and in real-time.

2.9.4 Datasets Used

The paper does not mention any specific datasets used. It focuses on the broader concepts and technologies related to data management in smart cities, rather than specific datasets or data sources. If you are interested in datasets related to smart cities, you would need to explore other sources or repositories that provide such data.

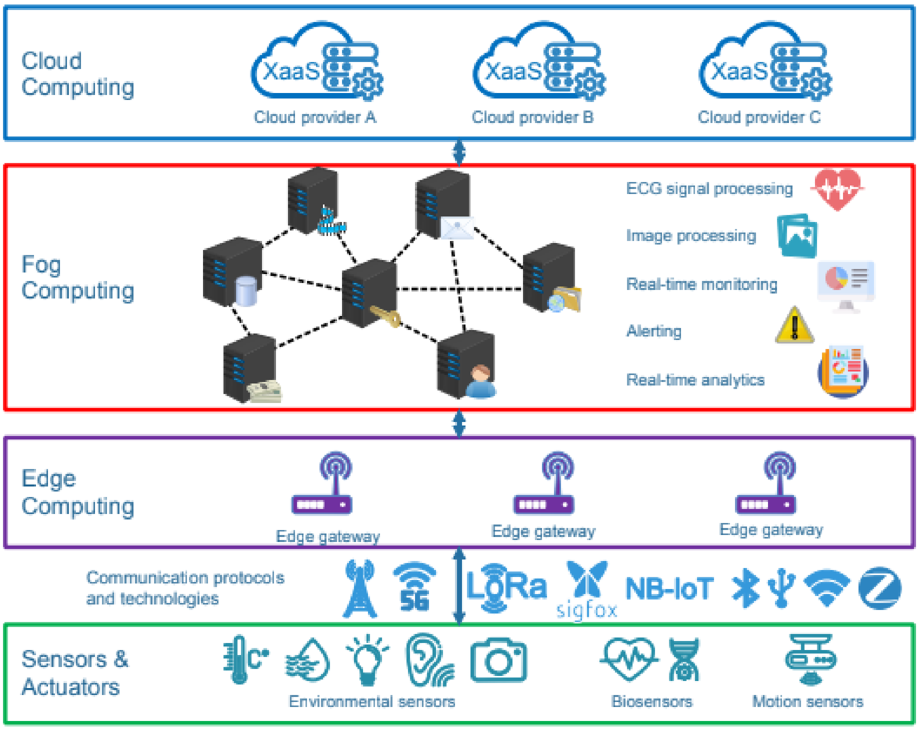


Figure 9: Software architecture diagram for Paper 9.

2.9.5 Paper Link

Access the full paper at https://www.mdpi.com/1999-5903/12/11/190.

2.10 Paper 4: A hybrid framework for multimedia data processing in IoT-healthcare using blockchain technology

Journal/Conference Rank:Q2
Publication Year: 2020
Reference: [10]

2.10.1 Summary

The paper discusses the use of multimedia techniques in healthcare systems, which allow for the storage, processing, and transfer of patient data in various formats such as images, text, and audio. It highlights that healthcare organizations worldwide are transforming into more efficient and user-centered systems through the use of multimedia. However, the management of large volumes of data, including reports and images, poses challenges in terms of increased human effort and security risks. To address these issues, the paper suggests that the Internet of Things (IoT) can enhance patient care and reduce costs by efficiently allocating medical resources. The authors also discuss potential threats to IoT devices initiated by various intruders. They highlight unethical practices in the healthcare industry, such as doctors recommending unnecessary tests and medicines from specific, potentially untrustworthy organizations. The paper emphasizes the need for security and transparency in IoT solutions. To address these concerns, it proposes the use of Blockchain technology, which can provide security and transparency in real-time conditions. The paper describes a security framework for healthcare multimedia data using Blockchain technology. It involves generating hashes for each piece of data to ensure the integrity of records and prevent unauthorized changes or breaches.

2.10.2 Software Architecture

The proposed healthcare system using Blockchain technology consists of a web-based application with two main components: the front end, which interacts with patients, and the back end, which handles internal communication using Blockchain. A blockchain network is responsible for authenticating user legitimacy, and there are two gateway routers that provide internet connectivity. Miners or authenticating nodes validate transactions, while executing nodes provide services to users' requests.

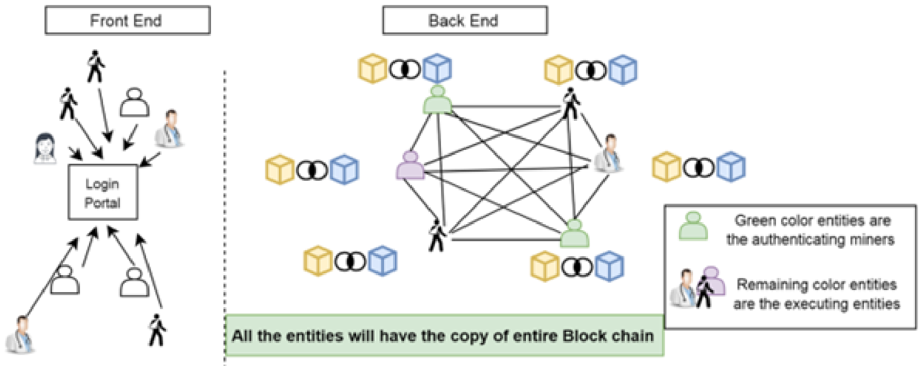


Figure 10: Software architecture diagram for Paper 3.

2.10.3 Data Parameters

The paper mentions the use of NS2 simulator to assess the security of the proposed framework. It conducts experiments to measure various parameters, including worm hole attacks, packet drop ratios, falsification attacks, and probabilistic scenarios for authentication. The data parameters include factors related to malicious nodes, security threats, product drop ratios, authentication mechanisms, and the detection of malicious nodes.

2.10.4 Datasets Used

The experimental evaluation of the proposed framework and a conventional approach was conducted successfully. The results were assessed based on various parameters related to system performance and behavior. The proposed system exhibited positive outcomes across all performance parameters, making it suitable for healthcare applications. The accuracy of the proposed approach was approximately 86 percent, and this accuracy is expected to improve over time as malicious nodes (MNs) are detected and removed from the system. The detection of MNs is based on trust, and the removal of theseThe paper mentions the use of NS2 simulator to assess the security of the proposed framework. It conducts experiments to measure various parameters, including worm hole attacks, packet drop ratios, falsification attacks, and probabilistic scenarios for authentication. The data parameters include factors related to malicious nodes, security threats, product drop ratios, authentication mechanisms, and the detection of malicious nodes. detected

MNs does not negatively impact the performance of other nodes. The trust ratings of nodes are continually computed at specific intervals, and nodes that exhibit compromised or malicious behavior receive low trust ratings due to factors such as high product loss ratios, susceptibility to attacks, and falsification attempts. These nodes are subsequently excluded from consideration in future transactions. The proposed system's transparency, facilitated by the tracking of activities among neighboring nodes, contributed to improvements in various aspects. Notably, the product loss ratio in the proposed system was lower compared to existing approaches, thanks to the recording of each transaction in the blockchain. The use of blockchain reduced the likelihood of unauthorized modifications or alterations in transmitted data.

2.10.5 Paper Link

Access the full paper at https://link.springer.com/article/10.1007/s11042-019-07835-3.

2.11 Paper 5: Big healthcare data: preserving security and privacy

Journal/Conference Rank: Q2
Publication Year: 2018
Reference: [11]

2.11.1 Summary

The paper discusses the significant impact of big data in the healthcare industry, highlighting its potential to enhance patient outcomes, predict epidemics, reduce healthcare costs, and improve overall quality of life. However, it also emphasizes the critical need for addressing security and privacy challenges in utilizing big data in healthcare. The authors reviewed various security and privacy issues related to big healthcare data and discussed potential solutions, focusing on anonymization and encryption methods. They also explored different data protection laws and regulations worldwide, emphasizing the importance of managing and safeguarding personal information. The paper concludes with a discussion of privacy-preserving methods used in big data, highlighting the limitations of existing techniques and the need for further enhancements.

2.11.2 Software Architecture

The paper does not delve into specific software architecture but discusses concepts related to data security and privacy in the context of big data. It mentions the use of various technologies such as authentication, encryption, data masking, access control, monitoring, and auditing to safeguard healthcare data. Additionally, it suggests the implementation of these technologies in conjunction with other security techniques to ensure comprehensive data protection.

2.11.3 Data Parameters

The paper primarily focuses on the security and privacy of healthcare data. It discusses data parameters related to personal and sensitive information of patients, as well as healthcare-related data such as medical records. The data parameters encompass aspects

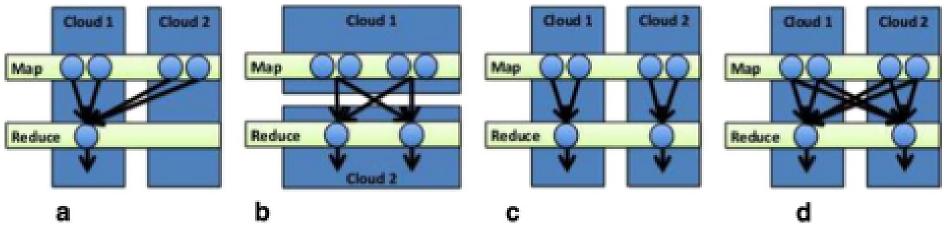


Figure 11: Software architecture diagram for Paper 11.

of data collection, transformation, modeling, and knowledge creation phases, emphasizing the need for safeguarding sensitive information throughout the data lifecycle.

2.11.4 Datasets Used

The paper does not mention the specific use of a particular data set. Instead, it discusses general principles and methodologies for securing and anonymizing healthcare data, addressing the privacy concerns associated with big data in the healthcare sector. The paper draws examples and concepts from various sources to illustrate its points and provide insights into data privacy and security challenges in healthcare. The paper provides a comprehensive overview of the privacy and security challenges in the healthcare sector when dealing with big data. It underscores the need for robust security measures to protect patient data and discusses several privacy-preserving techniques.

2.11.5 Paper Link

Access the full paper at https://link.springer.com/article/10.1186/s40537-017-0110-7.
Member 3: Abu Ahmed Rafi

2.12 Paper 1: Treatment Level and Store Level Analyses of Health

Journal/Conference Rank: Q2
Publication Year: April 2019
Reference: [1]

2.12.1 Summary

The paper discusses general approaches to analyze and model healthcare data at the treatment level and at the store level. The first part of the paper focuses on developing a modeling framework to understand the factors influencing the sales volume of stores maintained by a healthcare organization. The second part of the paper presents a treatment-level approach to modeling healthcare expenditures, aiming to improve the operational-level management of a healthcare provider by predicting the total cost of medical services. The paper utilizes an extension of the frequency-severity approach from actuarial science literature to analyze a specific type of medical data commonly found in a healthcare provider's standardized database. The paper also discusses the use of generalized linear models (GLMs) to analyze non-normal responses in insurance claims' data, highlighting the flexibility and advantages of GLMs in the insurance industry. The research project was conducted by a team of undergraduate and graduate students, along with a professional predictive analytics modeling consultant, in collaboration with a non-profit healthcare provider. The goal was to analyze treatment-level and store-level data to provide insights for the healthcare provider's operation. Overall, the paper provides methods and insights for analyzing healthcare data at both the treatment level and the store level, with a focus on predicting sales volume and healthcare expenditures. It also highlights the use of GLMs for analyzing non-normal responses in insurance claims' data.

2.13 Software Architecture

Describe the software architecture used in the paper.

2.13.1 Data Parameters

List and describe the data parameters used in the paper.

2.13.2 Datasets Used

Describe the datasets used in the paper and their significance.

2.13.3 Paper Link

$Accessthefullpaperat Accessthefullpaperathttps : //www.researchgate.net/publication/332483108_{Tr}$

2.14 Paper 2: Economic Value of Data and Analytics for Health Care Providers

Journal/Conference Rank: Q1
Publication Year: November 2020
Reference: [2]

2.14.1 Summary

The paper investigates the economic impact of data and analytics for health care providers, focusing on technologies beyond computer-based patient records. The review identified five major technology categories: electronic health records (EHRs), computerized clinical decision support, advanced analytics, business analytics, and telemedicine. Overall, 62 percent of the reviewed studies indicated a positive economic impact for providers, either through direct cost or revenue effects or through indirect efficiency or productivity improvements. While the economic impact of EHRs was ambiguous, analytics technologies like computerized clinical decision support and advanced analytics predominantly showed economic benefits. The mixed results regarding EHRs can create an economic barrier for adoption by providers, which can hinder the positive economic effects of analytics technologies relying on EHR data. More research is needed on the economic effects of technologies other than EHRs to generate a more reliable evidence base.

2.14.2 Software Architecture

Describe the software architecture used in the paper.

2.14.3 Data Parameters

List and describe the data parameters used in the paper.

2.14.4 Datasets Used

Describe the datasets used in the paper and their significance.

2.14.5 Paper Link

Access the full paper at https://www.jmir.org/2020/11/e23315/.

2.15 Paper 3: The Potential Health Care Costs and Resource Use Associated With COVID-19 In The United States

Journal/Conference Rank: Q1
Publication Year: April 2020
Reference: [1]

2.15.1 Summary

The paper focuses on estimating the direct medical costs and resource use associated with COVID-19 in the US. A Monte Carlo simulation model was developed to represent the US population and predict the potential economic burden of the disease. A single symptomatic COVID-19 case could incur a median direct medical cost of 3,045 dollars during the infection alone. If 80 percent of the US population were to get infected, there could be a median of 44.6 million hospitalizations, 10.7 million ICU admissions, 6.5 million patients requiring a ventilator, 249.5 million hospital bed days, and 654.0 billion dollars in direct medical costs over the course of the pandemic. If 20 percent of the US population were to get infected, there could be a median of 11.2 million hospitalizations, 2.7 million ICU admissions, 1.6 million patients requiring a ventilator, 62.3 million hospital bed days, and 163.4 billion dollars in direct medical costs over the course of the pandemic.4 Additional Information: The direct medical cost of a symptomatic COVID-19 case tends to be substantially higher than other common infectious diseases. The scarcity of critical supplies during a pandemic could drive up costs, and indirect medical costs or effects such as decreased revenue and potential cost increases due to worse disease outcomes were not included in the analysis. Recruiting healthcare professionals to focus on COVID-19 could lead to shortages in professionals for other patients, resulting in increased operating costs for healthcare systems.

2.15.2 Data Parameters

List and describe the data parameters used in the paper.

2.15.3 Datasets Used

Describe the datasets used in the paper and their significance.

2.15.4 Paper Link

Access the full paper at https://www.jmir.org/2020/11/e23315/.

2.16 Paper 4: SPECIAL SECTION ON BLOCKCHAIN TECHNOLOGY: PRINCIPLES AND APPLICATIONS

Journal/Conference Rank: Q1
Publication Year: August 2021
Reference: [1]

2.16.1 Summary

The paper discusses the integration of Blockchain 3.0 and Healthcare 4.0 to design a smart healthcare system that provides transparency, accessibility, security, and efficiency. The authors aim to validate the healthcare 4.0 processes used for data accessibility through statistical simulation-optimization methods and algorithms. The paper explores the implementation of blockchain in the Ethereum network using programming languages like solidity and tools like web3.js and Athena. It presents a comparative survey of state-of-the-art blockchain-based smart healthcare systems, including methodology, applications, requirements, outcomes, and future directions. The paper focuses on optimizing the performance of blockchain-based decentralized applications for smart healthcare systems and designing smart contracts to expedite trust-building and payment systems. The proposed system is validated through simulation and implementation, showing promising results in terms of gas value, block utilization, and smart contract execution time. The paper emphasizes the importance of accurate and timely medical records, transparency, and security in the healthcare system, which can be achieved through blockchain technology. It highlights the advantages of the smart healthcare system for all stakeholders and clarifies that it aims to enhance the existing healthcare system rather than replacing doctors or medical staff with automated systems.

2.16.2 Data Parameters

List and describe the data parameters used in the paper.

2.16.3 Datasets Used

Describe the datasets used in the paper and their significance.

2.16.4 Paper Link

Access the full paper at https://ieeexplore.ieee.org/abstract/document/9509863.

2.17 Paper 5: Web Resources for SARS-CoV-2 Genomic Database Anno

Journal/Conference Rank: Q1
Publication Year: May 2023
Reference: [1]

2.17.1 Summary

Many web resources have been developed to store, collate, analyze, and visualize SARS-CoV-2 genomic data, aiding in genomic analysis and understanding the transmission and evolution of the virus. Online dashboards gather, analyze, and visualize SARS-CoV-2 genomic data, allowing users to track mutation, phylogenetic lineage, geographic location, and temporal distribution of the virus. These dashboards help scientists and non-professionals track the virus in real time. Web tools and dashboards provide an easy way to explore virus evolution and transmission, helping researchers, policymakers, and the public adjust control policies and public health response. Some web resources for SARS-CoV-2 genomics include UShER for analysis, Taxonium for visualization, and cov-lineages.org for links to Pango lineages. These resources provide comprehensive and integrated information and experience. Web resources analyze, interpret, and visualize SARS-CoV-2 genomic data, helping us understand the spread and evolution of the virus. These resources benefit from the sharing of sequencing, experimental, and computational data, playing an important role in controlling the pandemic and protecting public health.

2.17.2 Data Parameters

List and describe the data parameters used in the paper.

2.17.3 Datasets Used

Describe the datasets used in the paper and their significance.

2.17.4 Paper Link

Access the full paper at https://www.mdpi.com/1999-4915/15/5/1158.

Member 4: Khatune Jannat Orpa

2.18 Paper 1: Design of Health Care Monitoring System Based on Internet of Thing (IOT)

Journal/Conference Rank: N/A
Publication Year: 2020
Reference 1: [12]

2.18.1 Summary

The design and deployment of an IoT-based healthcare monitoring system are covered in the article. The system makes use of modern communication techniques, remote physiological measurement technology, and advanced information technology. It intends to improve older citizen monitoring and offer remote health care services. The system gathers data from numerous sensors and stores it on a local server so that consumers, doctors, and other professionals may access it instantly. The system is anticipated to improve senior people's safety and well-being by increasing accessibility, efficacy, and cost-effectiveness. For IoT-based health systems, Freescale focuses on designing and implementing integrated technologies. The business highlights the value of microprocessors because they provide users with powerful graphical interfaces. For the interpretation and transmission of sensor data to web servers, health gateways are essential. Additionally, Freescale emphasizes the use of microcontrollers and sensors for collecting medical data and their use in processing, analyzing, and wirelessly sending information.

2.18.2 Software Architecture

The system includes integrated terminal software and enhanced healthcare modules to facilitate real-time activities of elderly citizens and monitor the healthcare system. It is likely that the software architecture of the system involves components for data collection from sensors, data processing and analysis, storage on a local server, and communication with healthcare professionals and practitioners.

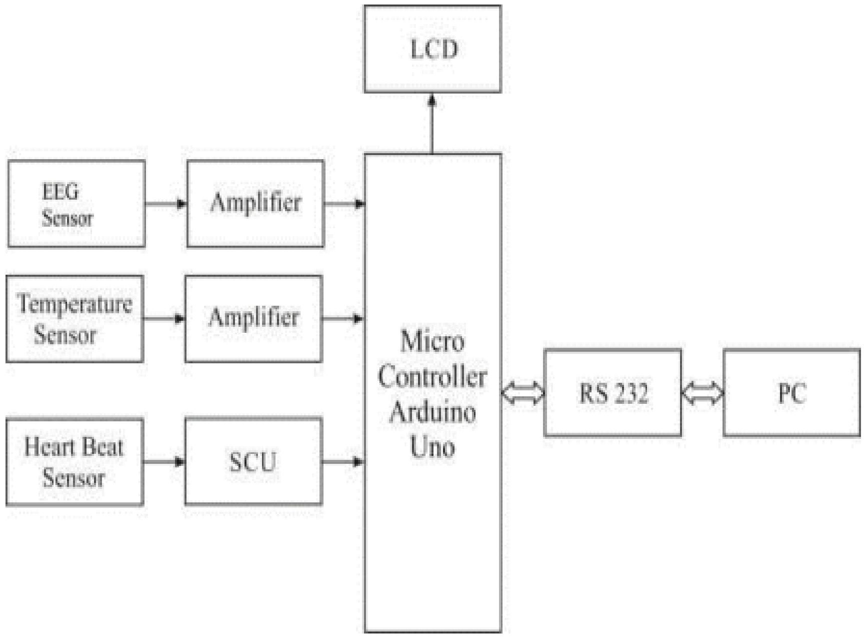


Figure 1 : PC-connected sensor block diagram.

Figure 12: Fig. PC-Connected Sensor Block Diagram

2.18.3 Data Parameters

The focus of the paper is more on the use of advanced information technology, new communication developments, and remote physiological measuring technology to create a remote health care system. The system collects and processes data from various sensors to monitor the health of elderly citizens in real-time. The collected data is stored on a local server and made available to healthcare professionals and practitioners. The paper also mentions the use of patient data-gathering sensors and microcontrollers for processing, analyzing, and transmitting data wirelessly.

2.18.4 Datasets Used

The paper mentions the use of various sensors to collect physiological information from patients, which is then stored on a local server. The collected information is made available to healthcare professionals and practitioners in real-time. It is possible that the data collected from the sensors is used as a dataset for monitoring and analyzing the health of elderly citizens. However, the paper does not provide specific details about the datasets used. The focus of the paper is more on the design and implementation of the system rather than the specific datasets used.

2.18.5 Paper Link

Access the full paper at https://ieeexplore.ieee.org/abstract/document/9254291?fbclid=IwAR1re2AFX
VAxSgGr-7CYYgvb-f61Z7jPqziXTVngJHI.

.

2.19 Paper 2: Impact of coronavirus syndromes on physical and mental health of healthcare workers: Systematic review and meta-analysis

Journal/Conference Rank: Q1
Publication Year: 2020
Reference: [13]

2.19.1 Summary

This research looks at how viruses like SARS, MERS, and COVID-19 affect the health of healthcare workers. They found that many healthcare workers got sick with symptoms like fever, cough, and muscle pain (75.9 percent for fever, 47.9 percent for cough). It also showed that many of them felt worried about their health (62.5 percent) and had trouble sleeping (37.9 percent). The study underscores the substantial impact of these syndromes on HCWs' well-being, emphasizing the need for public health strategies to prioritize their physical and mental health.

These diseases are known to spread rapidly and put significant pressure on healthcare systems. Doctors and nurses are at high risk for getting sick because of viruses like SARS, MERS, and COVID-19. They often don't have enough protective gear, and the stress and worry about their health make things harder. They reviewed 2,925 citations, ultimately including 115 studies that covered 60,458 healthcare workers. Data was independently extracted, and the risk of bias was assessed. The meta-analysis focused on physical and mental health outcomes, showing the prevalence of symptoms such as fever, cough, and myalgias in healthcare workers infected by these viruses.

In terms of mental health outcomes among healthcare workers exposed to SARS/MERS/COVID-19, the most frequently reported symptoms include general health concerns (62.5 percent), fear (43.7 percent), insomnia (37.9 percent), psychological distress (37.8 percent), burnout (34.4 percent), anxiety features (29.0 percent), depressive symptoms (26.3 percent), post-traumatic stress disorder (PTSD) features (20.7 percent), somatization (16.1 percent), and stigmatization feelings (14.0 percent). Notably, PTSD features were more prevalent in MERS (40.7 percent) compared to SARS (16.7 percent) and COVID-19 (7.7 percent). The quality of the included studies varied, with an average quality score of 3.2. Female healthcare workers were more likely to report myalgias and sore throat, while psychological distress was associated with female sex, younger age, and the type of healthcare profession, with nurses reporting higher distress compared to physicians or multi-professional samples. No other significant associations were found in the meta-regressions.

This meta-analysis focused on healthcare workers (HCW) exposed to SARS, MERS, and COVID-19, revealing the impact on their physical and mental health. Common physical symptoms among HCW included fever, cough, myalgias, and fear. Mental health issues were also prevalent, with general health concerns, fear, psychological distress, and burnout reported. HCW experienced higher rates of anxiety and depressive symptoms compared to the general population, but lower rates of PTSD features. The study underscores the significant health burden on HCW during infectious disease outbreaks and highlights the need for tailored support and screening to address their specific needs.

2.19.2 Software Architecture

The study protocol was registered on PROSPERO and followed the PRISMA and MOOSE checklists for systematic reviews and meta-analyses. The authors mention using the "Mixed Methods Appraisal Tool" (MMAT) for assessing the risk of bias, but it is not clear if this tool is related to software architecture.Overall, the paper focuses on the impact of coronavirus syndromes on the physical and mental health of healthcare workers, rather than discussing the software architecture used in the study.

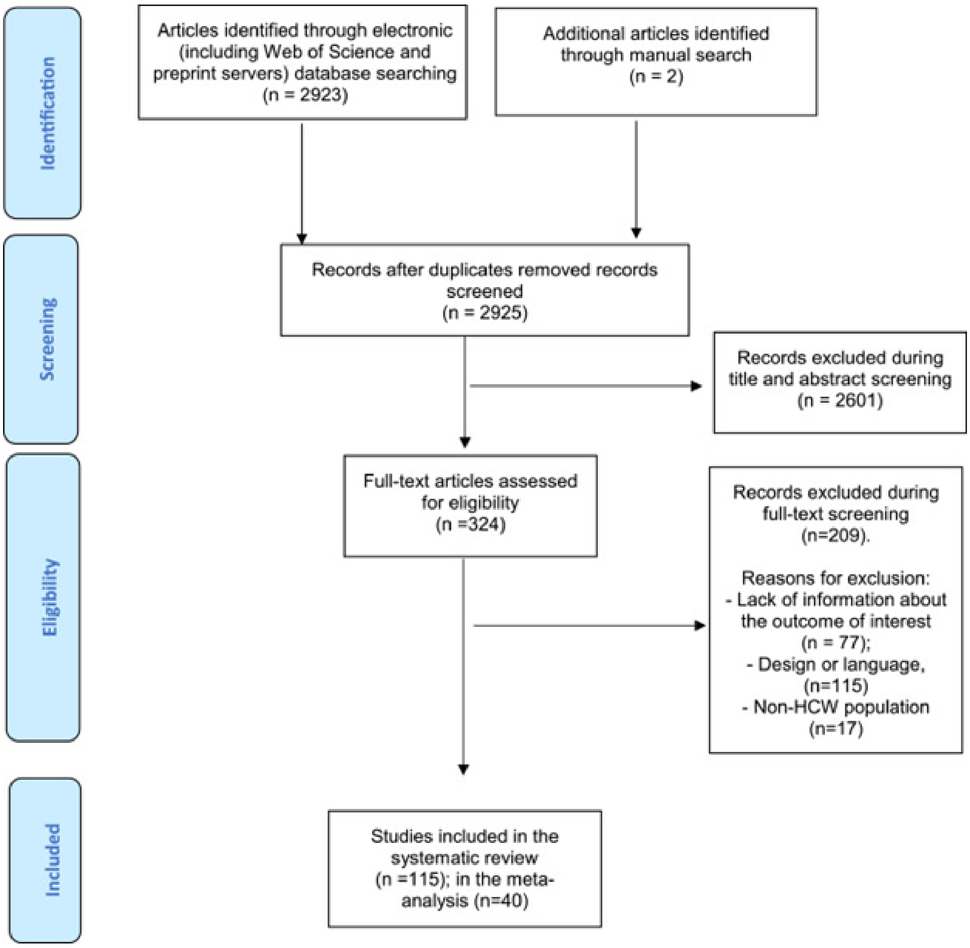


Figure 13: Fig. Block Diagram

2.19.3 Data Parameters

The authors conducted a systematic review and meta-analysis of studies reporting physical and mental health outcomes in healthcare workers (HCW) infected or exposed to Severe Acute Respiratory Syndrome (SARS), Middle East Respiratory Syndrome (MERS), and Novel coronavirus (COVID-19).The data for the review was collected from the Web of Science and grey literature sources.The included articles involved a total of 60,458 healthcare workers.

2.19.4 Datasets Used

The selected variables for data extraction included first author and year of publication, country, topic investigated, HCW category involved, sample size, age, sex, physical/mental health outcomes, data source, quality assessment, and key findings .The quality assessment of the included studies was conducted using the Mixed Methods Appraisal Tool (MMAT) .

2.19.5 Paper Link

Access the full paper at https://www.sciencedirect.com/science/article/pii/S0165032720323806?fbclid=

2.20 Paper 3: Internet of Things: A survey of enabling technologies in healthcare and its applications

Journal/Conference Rank: Q1
Publication Year: 2019
Reference: [14]

2.20.1 Summary

The Internet of Things (IoT) and healthcare applications are discussed in this study, with an emphasis on an IoT healthcare system built on the Wireless Body Area Network (WBAN). The most recent network topology and applications used in IoT-based healthcare solutions are reviewed, and the security and privacy issues that plague many IoT healthcare designs are examined. The obstacles and unresolved problems in IoT healthcare, such as power requirements, community healthcare services, and indirect emergency healthcare, are also examined in the article. The potential for further study in IoT healthcare is highlighted, and it offers insights into IoT and e-healthcare policies and systems. The discussion of research gaps and recommendations for future research directions in the area of IoT healthcare make up the paper's conclusion.

2.20.2 Software Architecture

The sources mainly focus on the Internet of Things (IoT) in healthcare, wireless body area networks (WBANs), network architecture topology, applications, security, privacy features, and future research possibilities. While the paper discusses the IoT-based healthcare system and various IoT technologies and applications in healthcare, it does not provide specific details about the software architecture used in these systems. Therefore, it can be inferred that the software architecture is not the main focus of this paper.

2.20.3 Data Parameters

The paper discusses the importance of parameters in ensuring the accuracy, reliability, and quality of signals in IoT healthcare applications. The medical server in the healthcare

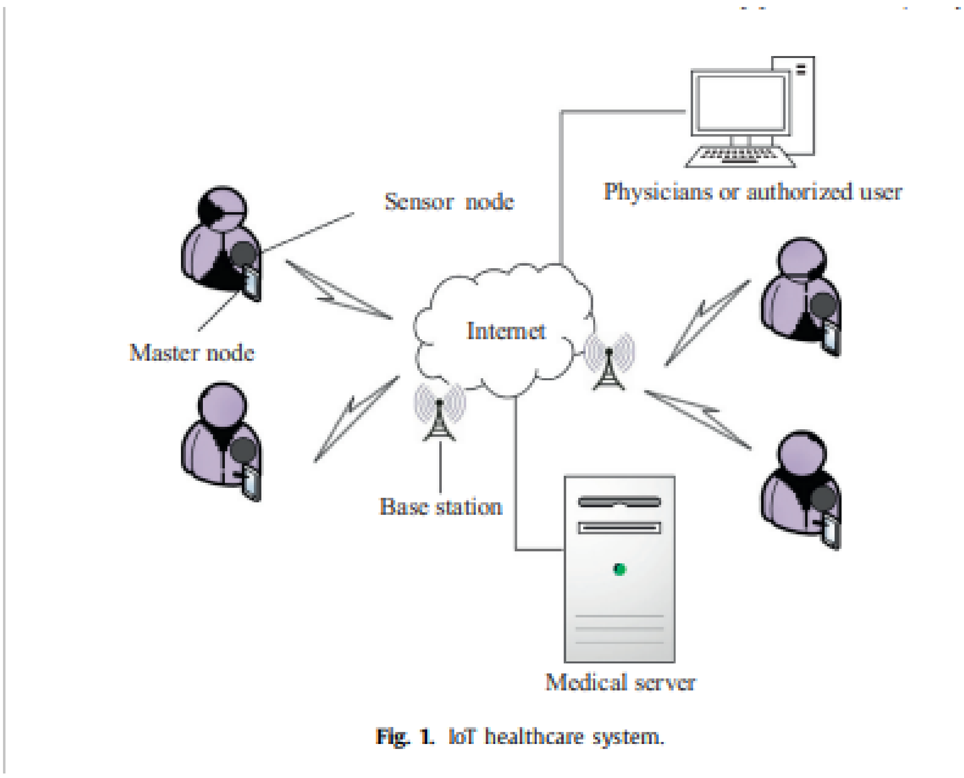


Figure 14: Fig.IoT Healthcare System

system is responsible for analyzing and recognizing health analysis, which suggests the presence of data parameters related to health analysis. It emphasizes the importance of parameters in ensuring the effectiveness and reliability of IoT healthcare applications.

2.20.4 Datasets Used

The paper discusses the state-of-the-art network architecture topology and applications in IoT-based healthcare solutions, but does not specifically mention any data sets used in the research. The paper mentions the use of a WSN system for patient health monitoring and real-time alarming, but does not provide details about the specific data sets used in this system.

2.20.5 Paper Link

Access the full paper at https://www.sciencedirect.com/science/article/abs/pii/S1389128619302695?fbc section-abstract.

2.21 Paper 4: Smart healthcare IoT applications based on fog computing: architecture, applications and challenges

Journal/Conference Rank: N/A
Publication Year: 2021
Reference 1: [15]

2.21.1 Summary

For many years, cloud technology has dominated healthcare information systems, but it has drawbacks including a slow service response time, which is crucial in emergency situations. Optimal computing technologies including cloud computing, edge computing, and fog computing have been suggested as solutions to these problems. The Internet of Health Things (Fog-IoHT) applications discussed in this research compare various computing technologies and offer a common architectural framework based on fog computing. The analysis's findings suggest that fog computing-based IoHT applications have enormous promise. Fog computing and IoHT applications are still in the early stages of integration, thus there are still a number of difficult issues that must be solved. The paper also examines the difficulties of incorporating fog computing into IoT healthcare applications as well as its potential uses. Its main goal is to offer a crucial roadmap for the future creation of fog-based healthcare IoT applications.

2.21.2 Software Architecture

The paper presents a common architectural framework based on fog computing for Internet of Health Things (Fog-IoHT) applications. The proposed fog-based healthcare IoT architecture framework aims to solve the high service response delay limitation of cloud-based healthcare IoT applications. The fog computing architecture is designed to enhance efficiency and security in healthcare IoT applications. The fog computing architecture includes fog servers with robust storage and high-performance computing ability, which communicate with each other through a core optical network. The fog computing architecture also includes end-user devices in the end-user layer. The fog computing architecture is compared to other computing technologies such as cloud computing and edge computing.

2.21.3 Data Parameters

The paper does not explicitly mention or discuss specific data parameters used in the research or analysis.

2.21.4 Datasets Used

The paper does not specifically mention or discuss any data sets used in the research or analysis.

2.21.5 Paper Link

Access the full paper at https://link.springer.com/article/10.1007/s40747-021-00582-9 .

2.22 Paper 5: Health Information Management: Implications of Artificial Intelligence on Healthcare Data and Information Management

Journal/Conference Rank: N/A
Publication Year: 2019
Reference: [16]

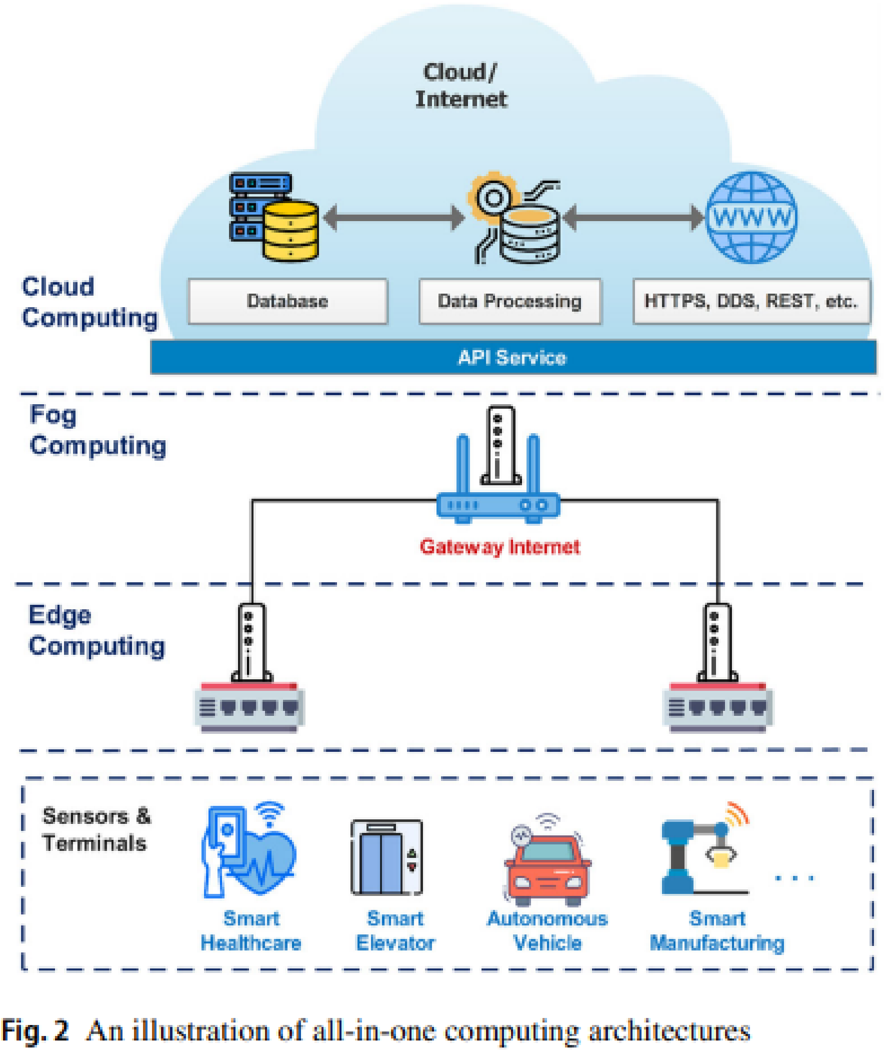


Figure 15: Fig. An Illustration of all-in-one computing architecture

2.22.1 Summary

The impact of AI on healthcare data management and the function of health information management (HIM) experts are covered in this paragraph. It highlights the need for better data quality by mentioning how AI influences several HIM processes, such as automated medical coding and healthcare data management. The sentence also emphasizes how HIM professionals must modify patient privacy procedures to account for AI. It recognizes the ongoing advancement of AI and the difficulties HIM professionals confront while managing healthcare data in an AI-driven world. The impact of digitization and artificial intelligence (AI) on HIM specialists is highlighted in this paragraph's introduction to how the health information technology industry has changed the health information management (HIM) profession. The predicted cost savings are highlighted together with legislative and monetary drivers for AI adoption in healthcare. The paragraph highlights the consequences of AI for the duties of HIM experts, data management, ethics, legislation, and the workforce as it anticipates extensive AI adoption in healthcare in the near future. The study's utilization of literature and interviews with HIM executives to glean insights is mentioned. The impact of AI on healthcare data management and the role of Health Information Management (HIM) specialists is discussed. AI affects various HIM procedures, including medical coding and data management. HIM professionals need specialized knowledge to ensure data quality and adapt to AI. They must also modify patient privacy practices. AI's continuous development presents both challenges and opportunities for HIM specialists, who play a crucial role in managing healthcare data effectively in an AI-driven environment.

2.22.2 Software Architecture

There is no information about software architecture in the provided sources.

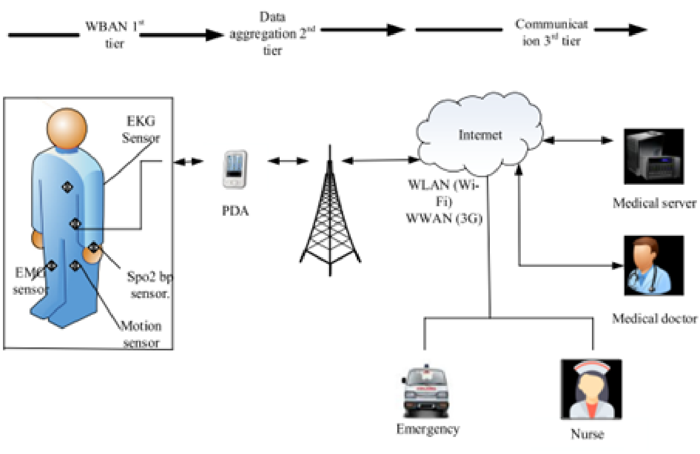


Fig. 3. Real time remote monitoring system.

Figure 16: Fig. Real-Time Remote Monitoring System

2.22.3 Data Parameters

It discusses the implications of artificial intelligence (AI) on the management of healthcare data and information, including automated medical coding, healthcare data management, patient privacy, and HIM workforce training and education. It highlights the need for data governance principles and the development of clear, consistent, and standardized policies and procedures for managing current and emerging sources of data, including EHR data, lab data, imaging data, claims data, patient-generated data, and metadata. The paper also mentions the challenges related to data quality, data sparsity, redundancy, missing values, and the need for data curation and data quality management in healthcare organizations. Overall, the paper focuses on the impact of AI on healthcare data and information management, but does not provide specific data parameters. The paper does not provide specific data parameters, but rather discusses the implications of AI on healthcare data management and the need for data governance and quality management.

2.22.4 Datasets Used

The paper discusses the implications of artificial intelligence (AI) on the management of healthcare data and information, but it does not specifically mention a dataset. However, it does mention that increased adoption of AI-enabled applications and more sophisticated use of these applications generate new and more varied data types. These data types include structured, semi-structured, or unstructured data collected remotely and automatically from multiple data sources. The proliferation of mobile sensors and wearable devices allows for the collection of additional streams of biomedical data, such as blood pressure, glucose levels, electrocardiogram readings, and measures of cognition and emotional health. The paper emphasizes the need for data governance principles and the development of clear, consistent, and standardized policies and procedures for managing current and emerging sources of data, including EHR data, lab data, imaging data, claims data, patient-generated data, and metadata. Overall, while the paper does not focus on a specific dataset, it highlights the importance of managing and governing various types of healthcare data generated by AI-enabled applications.

2.22.5 Paper Link

Access the full paper at https://www.thieme-connect.com/products/ejournals/html/10.1055/s-0039-1677913N108C7

Member 5: Safwan Sulaiman Sadi

2.23 Paper 1: Big data in healthcare: management, analysis, and future prospects

Journal/Conference Rank: Q2
Publication Year: 2019
Reference: [17]

2.23.1 Summary

The rapid expansion of data collection and storage has given rise to the concept of "big data," which refers to large and unmanageable datasets that surpass traditional storage and processing capabilities. Big data is characterized by three key dimensions: volume, velocity, and variety, known as the 3 Vs. Volume denotes the sheer size of the data, velocity refers to the speed at which data is collected and made accessible, and variety encompasses the different types of structured and unstructured data, including text, video, audio, and more. The term "veracity" has also been added as a fourth V, highlighting the importance of data accuracy and reliability. Big data has become a ubiquitous part of various industries, including healthcare. Healthcare organizations generate vast amounts of data related to patient medical records, clinical data, and other health-related information. With the digitization of medical records, electronic health records (EHRs) have become a standard practice, enabling the efficient management and retrieval of patient data. The application of artificial intelligence (AI) and machine learning (ML) techniques, such as neural networks, is crucial in making sense of this enormous volume of data and supporting automated decision-making in healthcare. Efficiently handling big data in healthcare has the potential to enhance the healthcare system's functionality and services, making it more interactive, efficient, and patient-centric. Visualization of healthcare data in a user-friendly manner is also vital for societal development. Big data plays a significant role in healthcare and various other industries. Its management and analysis require advanced computational power and sophisticated software tools, making it possible to derive valuable insights and improve services. Big data has the potential to transform healthcare and contribute to better patient care and outcomes.

2.23.2 Software Architecture

The paper used distributed computing platforms such as Hadoop and Apache Spark to handle handle large volumes of complex and heterogeneous data. These platforms implement MapReduce algorithm for parallel processing and analysis of data across multiple nodes or clusters.

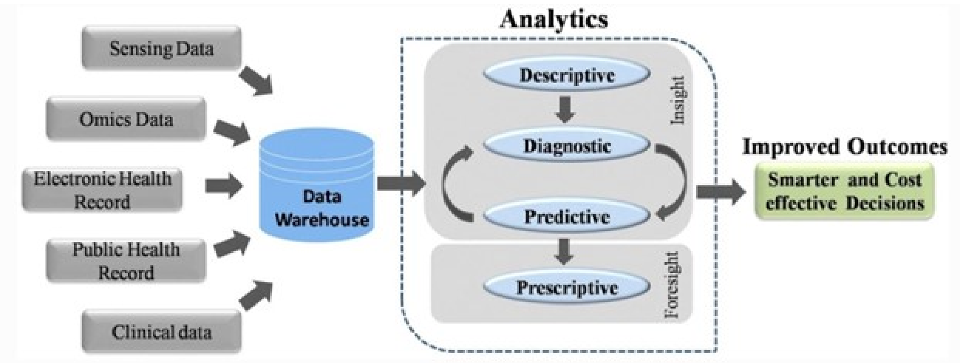


Figure 17: Fig 1.

2.23.3 Data Parameters

Data are collected from Electronic health records (EHRs), electronic medical records (EMRs), personal health records (PHRs), medical practice management software (MPM) and other healthcare components that store and manage clinical administrative data of the patients and providers.

2.23.4 Datasets Used

No specific set of data are used in this paper.

2.23.5 Paper Link

Access the full paper at Big data in healthcare: management, analysis and future prospects — Journal of Big Data — Full Text (springeropen.com).

2.24 Paper 2: Online Storage in Healthcare Organizations

Journal/Conference Rank: Q1
Publication Year: 2020
Reference: [18]

2.24.1 Summary

The challenges and opportunities surrounding healthcare data storage and management are hard to overcome and various sectors in medical data storage requires different approaches. The proliferation of smart medical devices and advanced diagnostic tools has led to a significant increase in the volume of healthcare data. Researchers have emphasized the importance of effectively harnessing this "big data" to improve patient care, support clinical decision-making, and advance medical research. The text mentions various data storage options, including onsite storage, cloud storage, and traditional storage media like DVDs and CDs. The advantages and disadvantages of each storage method has been observed and analyzed extensively. Cloud storage, in particular, has gained attention for its scalability and potential cost savings. Achieving interoperability between different healthcare organizations and systems is a common theme in healthcare data management research. Standards such as HL7 and FHIR are often discussed as ways to facilitate data exchange and integration between various healthcare applications and devices. Protecting patient data is a critical concern in healthcare. The text touches upon HIPAA (Health Insurance Portability and Accountability Act) regulations, which mandate strict security and privacy measures for healthcare data. Research has explored encryption, authentication methods, and secure data sharing protocols to address these concerns. The text proposes a patient-centric approach to data management, where patients are encouraged to take an active role in storing and managing their health data. Research here discusses the benefits and challenges of empowering patients to control their health information. The Journal suggests strategies to avoid data duplication and emphasizes the importance of maintaining reference copies of normal test results for patients. Similar approaches have been explored in the literature to streamline data storage and reduce redundancy. The cost-effectiveness of different data storage solutions is a recurring theme. The text highlights the potential long-term costs associated with cloud storage, prompting a need for cost-benefit analyses. Existing research has conducted similar analyses to help healthcare organizations make informed decisions. It is advised to avoid using online personal storage solutions like email drives, Google Drive, and Dropbox for healthcare data storage. Research has considered the feasibility and security implications of using such platforms for sensitive medical information. The text anticipates the increasing connectivity of smart devices and the role of the internet in healthcare data access. Research often explores emerging trends in healthcare technology, such as the Internet of Things (IoT) and mobile health (mHealth) applications. Healthcare data management encompasses a wide range of topics, including data storage options, interoperability, security, patient involvement, cost analysis, and emerging technologies. Researchers in this field aim to address the complex challenges while leveraging the potential benefits of modern healthcare data systems.

2.24.2 Software Architecture

Users register on a web based application using their email account which grants permission for the healthcare providers to access the users online storage. The web-based application communicates with a local storage to authenticate and provide valid data to the user's online storage

2.24.3 Data Parameters

Data are collected from medical devices, body sensors, mobile healthcare applications, etc. The data size here are large and expanding due to technology development and high resolution.

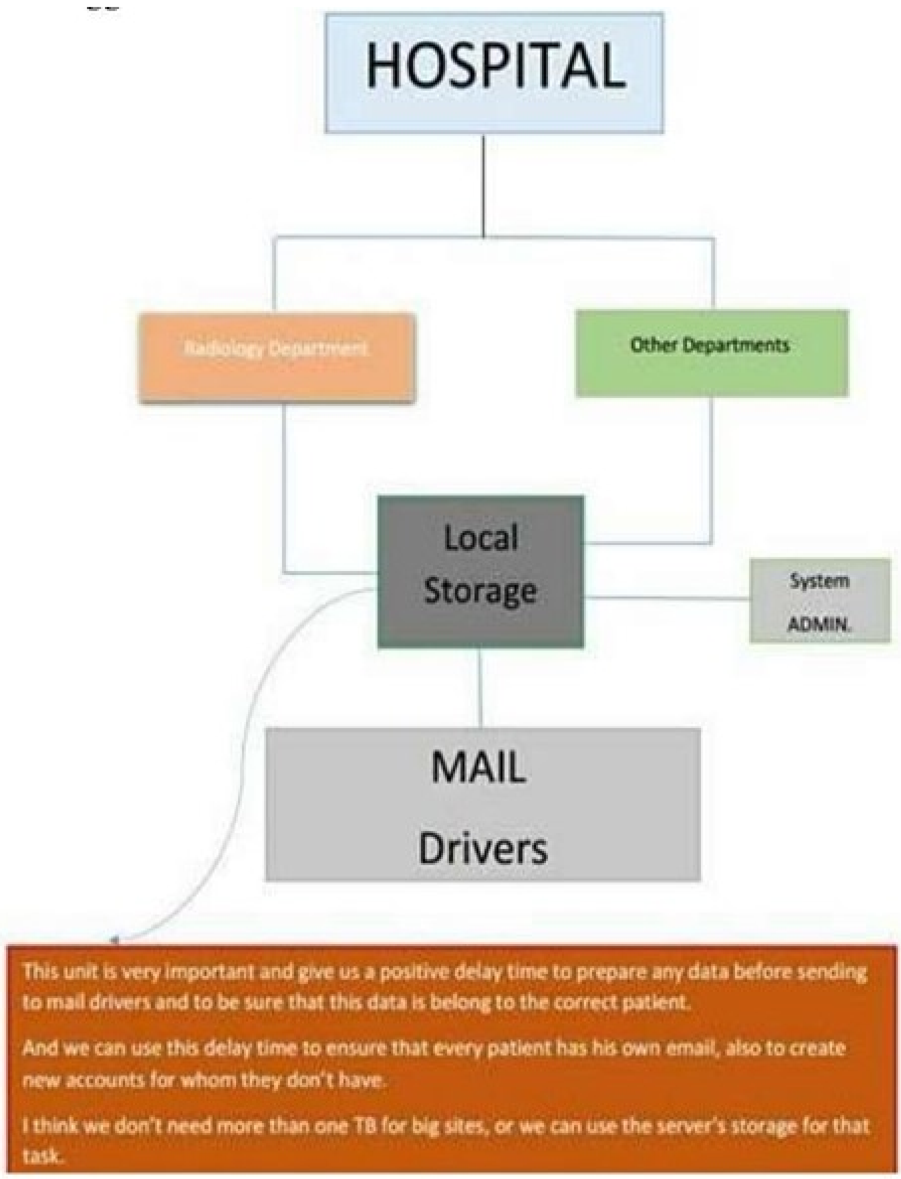


Figure 18: Fig. 2.

2.25 Datasets Used

No specific data set is used in this article. The main method of data collection in this article is from patient registration data (name, age, gender, address, phone number, email account, etc. This data set is used to identify and contact the patients and to link their email storage with the hospital information system (HIS).

2.25.1 Paper Link

Access the full paper at https://www.researchgate.net/publication/344152133$_{O}nline_{S}torage_{i}n_{H}ealthca$

2.26 Paper 3: Big Data in Healthcare and Medical Application in Romania

Journal/Conference Rank: N/A
Publication Year: 2016
Reference: [19]

2.26.1 Summary

The article introduces the concept and characteristics of Big Data (BD) and Big Data Analytics (BDA) in the context of health informatics. It also discusses the types of data sources and formats that are relevant for health care, such as electronic health records, medical images, genomic data, and social media data. The article presents some of the major challenges and benefits of using BD and BDA in health care, such as improving quality and efficiency of services, enhancing personalized care, and advancing research and innovation. It also describes some of the methods and technologies that are used to process and analyze BD, such as Hadoop, MapReduce, and cloud computing. It briefly mentions some of the applications of BD and BDA in health care and medical areas in Romania, such as telemedicine, disease surveillance, and clinical decision support.

The software implements a infrastructure that can store and manage large amounts of data, such as Hadoop Distributed File System (HDFS), which is a distributed file system that can handle petabytes of data across multiple nodes. Data processing framework that can perform parallel and distributed computation on large data sets, such as MapReduce, which is a programming model that divides a task into smaller subtasks and assigns them to different nodes for processing. An application of various analytical methods and tools is implemented to extract meaningful information from data, such as data mining, natural language processing, artificial intelligence, and predictive analytics. These methods can help identify patterns, correlations, anomalies, and insights from data. The presentation of data analysis results in a graphical or interactive way, such as charts, graphs, dashboards, or reports is shown. These visualizations can help communicate and interpret the data analysis outcomes to different stakeholders.

2.26.2 Software Architecture

The software implements a infrastructure that can store and manage large amounts of data, such as Hadoop Distributed File System (HDFS), which is a distributed file system that can handle petabytes of data across multiple nodes. Data processing framework that can perform parallel and distributed computation on large data sets, such as MapReduce, which is a programming model that divides a task into smaller subtasks and assigns them to different nodes for processing. An application of various analytical methods and tools is implemented to extract meaningful information from data, such as data mining, natural language processing, artificial intelligence, and predictive analytics. These methods can help identify patterns, correlations, anomalies, and insights from data. The presentation of data analysis results in a graphical or interactive way, such as charts, graphs, dashboards, or reports is shown. These visualizations can help communicate and interpret the data analysis outcomes to different stakeholders.

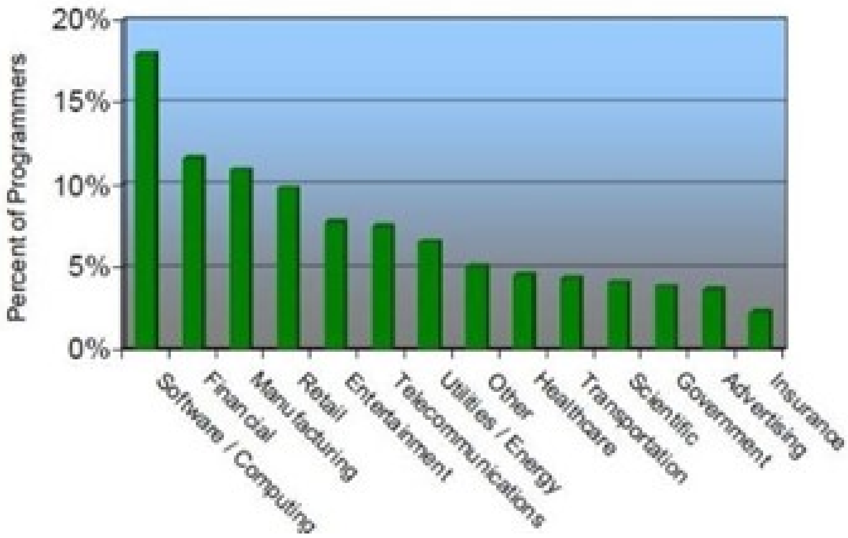


Figure 19: Fig. 3

2.26.3 Data Parameters

These are the various types of data that are relevant for healthcare, such as electronic health records, medical images, genomic data, and social media data. These data can be structured or unstructured, and can come from different locations and formats.

2.26.4 Datasets Used

No explicit data set is used in this paper. Data collected from Electronic Health Records (EHRs), Medical Images from radiology and fluoroscopy devices, Genomic data from genotyping and gene expression experiment, etc are used here.

2.26.5 Paper Link

Access the full paper at (1) (PDF) Big Data în Healthcare and Medical Applications in România (researchgate.net).

2.27 Paper 4: Data warehouse for mining and simulating medical records

Journal/Conference Rank: Q3
Publication Year: 2023
Reference: [20]

2.27.1 Summary

The paper talks about development of a web-based application that can store and organize patient records from different sources and diseases in a data warehouse, which can support decision making and community diagnosing in the healthcare sector. The authors describe the steps of extracting, transforming, and loading data from various operational data sources into a data staging area, where it is cleaned, integrated, and standardized. Then, the data is loaded into the data warehouse database using SQL Server Integration Services (SSIS). The authors present the methods and tools for analyzing and visualizing data from the data warehouse using SQL queries, SQL Server Analysis Services (SSAS), and SQL Server Reporting Services (SSRS). They also provide examples of reports and charts based on patient records of malaria and typhoid fever. The paper demonstrates how their data warehouse can help uncover hidden information, compare differences between patient groups, and determine critical factors that influence disease outcomes. They also discuss the advantages, limitations, and future work of their approach.

2.27.2 Software Architecture

A web application that integrates the front-end, middle-end and back-end together as a single system. It also integrates a data warehouse that stores and organizes patient records from three different tropical diseases: Malaria, Measles and Typhoid Fever. It then implements a web platform that provides a graphical user interface (GUI) for data mining, reporting and analysis using Microsoft Visio and MSSQL server reporting services.

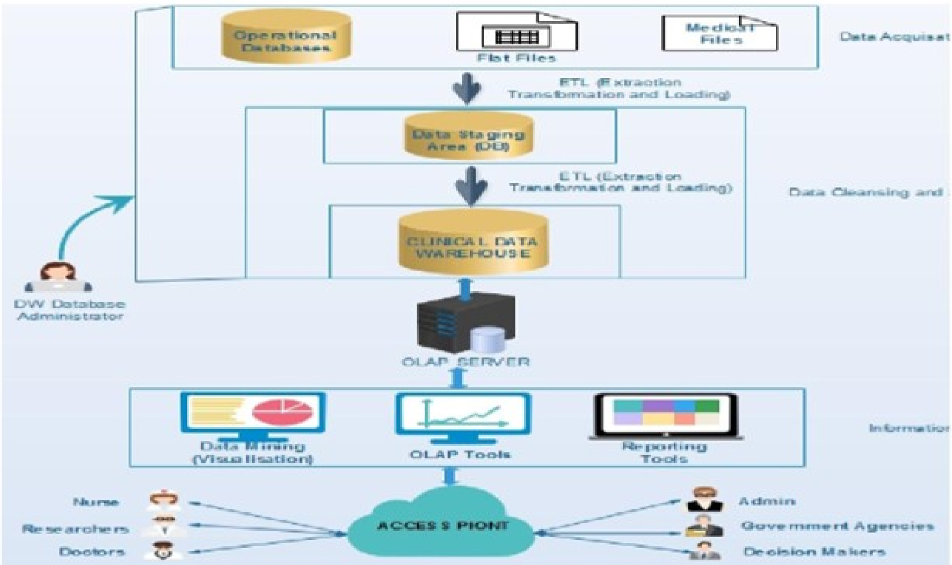


Figure 20: Fig.4

2.27.3 Data Parameters

The data warehouse is designed and implemented using Microsoft SQL Server 2019, SQL Server Integration Services (SSIS), SQL Server Analysis Services (SSAS), SQL Server Reporting Services (SSRS) and Microsoft Visio.

2.27.4 Datasets Used

Patient records from three different tropical diseases: Malaria, Measles and Typhoid Fever. These records are obtained from the operational data source system of a hospital in Nigeria

2.27.5 Paper Link

Access the full paper at (1) (PDF) DATA WAREHOUSE FOR MINING AND SIMULATING MEDICAL RECORDS (researchgate.net).

2.28 Paper 5: An Application of Web-based E-Healthcare Management System Using ASP.Net

Journal/Conference Rank: Q2
Publication Year: 2021
Reference: [21]

2.28.1 Summary

This paper presents a web-based e-healthcare management system that aims to provide easy and efficient access to health records and services for patients and healthcare professionals. The paper describes the design and implementation of the system using ASP.NET, CHash, SQL Server, and other technologies. The paper also discusses the security and privacy issues, the functions and benefits, and the application architecture of the system. The paper provides some screenshots of the system interfaces and diagrams of the system modules and components. The paper claims that the system can reduce errors and costs in healthcare delivery, improve the quality of healthcare information, and support telemedicine and home care services.

2.28.2 Software Architecture

The paper proposes a web-based e-healthcare management system that aims to provide easy and efficient access to health records and services for patients and healthcare professionals. The system uses a client-server model and a three-tier server architecture. It consists of a web application, a data warehouse, a data staging area, an OLAP server and a web platform for data mining, reporting and analysis.

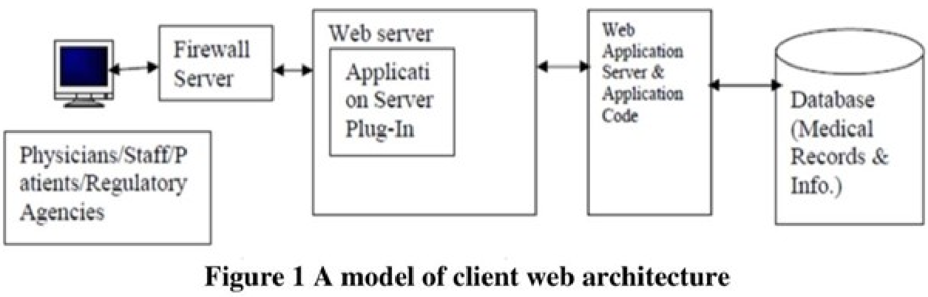


Figure 21: Fig. 5

2.28.3 Data Parameters

The paper collects data from the application proposed which includes patient data from patient records, Electronic health records (EHRs), Electronic medical records (EMRs), wearable devices, Telehealth and personalized medication routines.

2.28.4 Datasets Used

The data warehouse uses a three-tier server architecture and a multi-tier ETL process to integrate data from heterogeneous and disparate clinical data stores

2.28.5 Paper Link

Access the full paper at (1) (PDF) An Application of Web-based E-Healthcare Management System Using ASP.Net (researchgate.net).

Member 6: Tausif Ertiza Sameer

2.29 Paper 1: Paper Name 1: MIOTIC study: A prospective, multicenter, randomized study to evaluate the long-term efficacy of mobile phone-based Internet of Things in the management of patients with stable COPD

Journal/Conference Rank: N/A
Publication Year: 2013
Reference: [22]

2.29.1 Summary

The paper discusses the potential of using the Internet of Things (IoT), particularly mobile phone-based IoT (mIoT), for managing patients with stable COPD. It describes a randomized, multicenter, controlled trial known as the 'MIOTIC study.' The study involves patients with stable COPD and aims to evaluate the influence of mIoT on various parameters, including the frequency and severity of acute exacerbations, symptomatic evaluation, lung function, exercise capacity, and medical costs.The 'MIOTIC Study,' a multicenter, randomized trial examining the potential of mobile phone-based Internet of Things (mIoT) technology in managing stable Chronic Obstructive Pulmonary Disease (COPD). COPD poses a significant healthcare burden, and effective management is essential. The study aims to evaluate the impact of mIoT on COPD management, assessing factors like acute exacerbations, symptom control, lung function, exercise capacity, and medical costs over a year. Patients are randomly assigned to the mIoT or routine management groups. The study seeks to establish whether mIoT can reduce exacerbations and enhance patient care. Supported by Shanghai Science and Technology Committee and Fudan University.

2.29.2 Software Architecture

The paper mentions the use of a mobile phone-based IoT (mIoT) platform that integrates sensor networks, mobile communication networks, and cloud computing. The platform is used for monitoring patients' physiological parameters, providing medication reminders, allowing patients to report symptoms, and enabling communication with medical staff.

2.29.3 Data Parameters

healthcare data comprises a range of types, including electronic health records, medical images, genomic data, and social media data. These data may vary in structure, source,

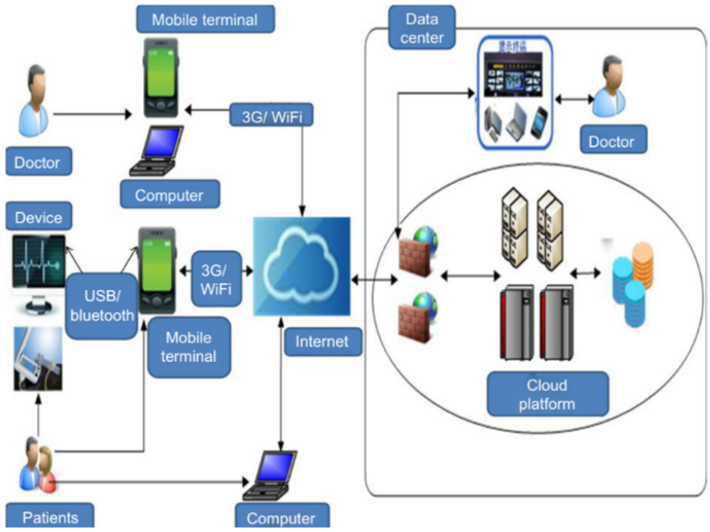


Figure 22: Software architecture diagram for Paper 1.

and format.The study assesses various endpoints, including the frequency and severity of acute exacerbations, symptomatic evaluation, lung function measurements, exercise capacity, and direct medical costs per year.Patients are assigned to the intervention or control group through a randomization process, ensuring an unbiased distribution.

2.29.4 Datasets Used

The mIoT platform allows patients to receive medication reminders, report symptomatic changes, access health education, and communicate with medical staff through their mobile devices.

2.29.5 Paper Link

Access the full paper at https://www.researchgate.net/publication/257250961$_{M}IOTIC_{s}tudy$.

2.30 Paper 2: AN ATTEMPT TO DEFINE CONTEXT AWARENESS IN MOBILE

Journal/Conference Rank: N/A
Publication Year: 2006
Reference: [23]

2.30.1 Summary

The paper discusses the development of a system named DITIS, designed for mobile eHealth environments. It aims to support healthcare professionals working in virtual teams to provide healthcare services beyond the confines of traditional healthcare facilities. The paper highlights the challenges and needs of multidisciplinary healthcare professionals and context-awareness in a wireless environment. The proposed system focuses on addressing these challenges.The paper discusses the importance of virtual healthcare teams consisting of various professionals (nurses, doctors, etc.) who collaborate remotely to provide continuous care to patients in their homes. The research introduces a web-based system called DITIS, designed to efficiently manage and facilitate collaboration among these virtual healthcare teams. DITIS enables secure access to medical information via mobile devices, adapting the data according to parameters such as user roles, access rights, device capabilities, and wireless connectivity. The paper also identifies the challenges and requirements of coordinating multidisciplinary healthcare professionals within a context-aware environment. Additionally, it briefly presents pilot implementations of the system and an evaluation study.

2.30.2 Software Architecture

The paper discusses the development of the DITIS system for context-aware mobile eHealth environments. The system architecture comprises five layers: Application/User, Workflows, Services, Sensors, and the Database, with the latter two operating in parallel. The Application/User layer houses the graphical user interface, offering flexible and efficient collaboration features that can be customized to meet organizational needs. The Workflows layer manages dynamic workflows, enabling the orchestration and coordination of system services in an ad-hoc manner. The Services layer provides fundamental system functionalities, including security, messaging, and database access. It allows for direct calls from the application or workflows. Additionally, the Sensors layer encompasses various sensors like temperature and vital sign monitors, while the Database layer houses the database management system (DBMS) for storing sensor data and managing user information, collaboration features, virtual teams, dynamic workflows, and more.

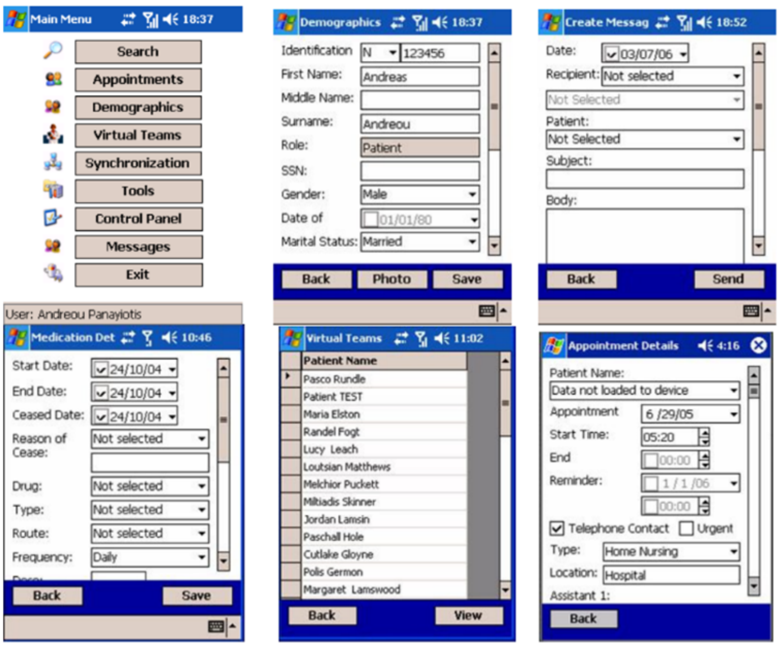


Figure 6. Example screens on mobile devices (standalone interface)

Figure 23: Software architecture diagram for Paper 1.

2.30.3 Data Parameters

It primarily focuses on describing the system's features, components, architecture, and the results of its implementation in a healthcare setting.For information regarding the specific data parameters used in the DITIS system, you may need to refer to the complete research paper or document from which this excerpt was taken. These data parameters could include details about patient records, medical information, questionnaires, actions, roles, and other relevant data used within the system. However, the excerpt you provided does not offer a detailed breakdown of these data parameters.

2.30.4 Datasets Used

The paper does not mention specific datasets used in the DITIS (Dynamic Interactive Telematic Intelligent System) or any healthcare-related datasets. It primarily describes the system's architecture, features, and the results of its implementation in a healthcare setting. If you are interested in the datasets used in the context of this system, you may need to refer to the complete research paper or document from which this excerpt was taken. The paper might contain information about the sources and types of datasets utilized in the DITIS system for testing, development, or research purposes.

2.30.5 Paper Link

Access the full paper at https://www.academia.edu/68795944/An$_{A}ttempt_{t}o_{D}efine_{C}ontext_{A}wareness.$

2.31 Paper 3: Health Care and Precision Medicine Research: Analysis of a

Journal/Conference Rank: Q1
Publication Year: 2019
Reference: [24]

2.31.1 Summary

This paper presents a comprehensive framework for handling large-scale healthcare data. It addresses the challenges of data storage and compression, achieving an 80.5 percent reduction in file size using Snappy-compressed Avro files. The system features a custom application for high-throughput data processing, converting monitor signals to Avro format, compressing with Snappy, and storing in HDFS. Additionally, original data copies are retained for potential reprocessing. Specialized analytics are highlighted to extract valuable insights from patient data, with a focus on biomedical research. Ethical considerations, such as institutional review board approval and patient consent, are discussed, ensuring compliance with regulatory standards. The paper also introduces a data science platform for real-time laboratory business intelligence, with a particular focus on improving testing efficiency and patient safety. The architecture of this platform is detailed, emphasizing the challenges of real-time data access and visualization in the laboratory setting. The study concludes by underlining the complexity of data science platforms and the importance of careful implementation, with the need for further research to harness the full potential of big data in healthcare.

2.31.2 Software Architecture

The software architecture described in the paper is designed to efficiently handle large-scale healthcare data. It encompasses a custom application built on the Storm platform for high-throughput data processing. This application is responsible for converting monitor signals to the Avro format, compressing the data using the Snappy codec, and storing it in the Hadoop Distributed File System (HDFS). Notably, it also maintains a separate copy of the original data for potential reprocessing needs. The architecture leverages Apache Spark for batch analysis, providing in-memory data processing to improve speed. It is a flexible and scalable framework that meets the unique challenges of managing and analyzing healthcare data efficiently.Nucleus Platform Architecture: The architecture for this laboratory data monitoring involves an HL7 stream of clinical observations and results messages, validation, mapping to JSON documents, and storage in various systems like HDFS and Elasticsearch.

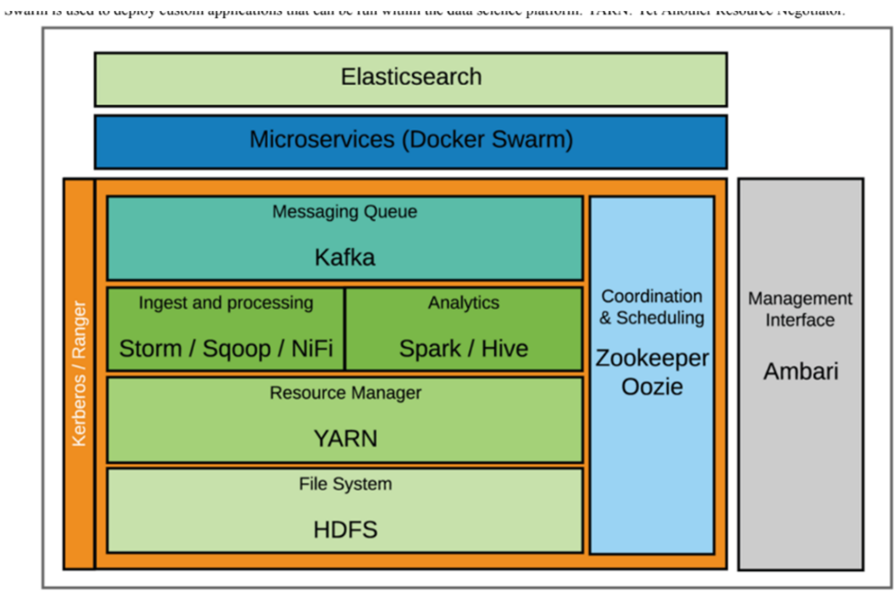


Figure 24: Software architecture diagram for Paper 1.

2.31.3 Data Parameters

Specialized analytics are needed for the acquired data. Traditional analytic methods and tools may not scale to meet these needs. To address this, the system uses Spark as the primary data analysis tool for batch analysis. Spark is a general data processing framework that can be used with common programming languages. It can maintain data in memory, improving processing speed.

2.31.4 Datasets Used

The data is captured during routine clinical care but is intended for use in biomedical research. Ethical considerations, such as institutional review board approval and patient consent, are necessary before analyzing the data. Additionally, there are mechanisms in place to filter data from patients who have explicitly opted out of research.

2.31.5 Paper Link

Access the full paper at https://www.jmir.org/2019/4/e13043/.

2.32 Paper 4: The doctor, the patient and the world-wide web: how the

Journal/Conference Rank: N/A
Publication Year: 2003
Reference: [24]

2.32.1 Summary

This paper discusses the impact of the internet on healthcare, emphasizing its role as an information resource for both patients and professionals. It highlights the potential benefits of the internet in educating and empowering patients, facilitating communication between doctors and patients, and providing support through virtual communities. The paper also addresses concerns about the quality of online health information and the need for research on the positive and negative health effects of the internet. It underlines the digital divide and the challenges of ensuring equitable access to online health resources.

2.32.2 Software Architecture

The paper does not focus on software architecture.

2.32.3 Data Parameters

The paper does not discuss specific data parameters.

2.32.4 Datasets Used

The paper does not mention the use of specific datasets.

2.32.5 Paper Link

Access the full paper at https://journals.sagepub.com/doi/epdf/10.1177/014107680309600206.

2.33 Paper 5: UceWeb: a web-based collaborative tool for collecting and sharing quality of life data

Journal/Conference Rank: Q1
Publication Year: 2015
Reference: [25]

2.33.1 Summary

The paper discusses the development and validation of a tool called UceWeb, designed for eliciting and assessing health-related quality of life (QoL) in patients. It employs a combination of questionnaires like EuroQol-5D and AFEQT and direct utility elicitation methods such as Standard Gamble (SG), Time Trade-Off (TTO), and Rating Scale (RS). The study examines the correlations between the scores obtained from these questionnaires and the direct elicitation methods, the time needed for administration, and other considerations related to using the tool for QoL assessments.

2.33.2 Software Architecture

UceWeb is a system that enables the collection of User Concerns (UCs) from patients, typically during face-to-face interactions with doctors or by patients themselves with proper training. In cases where patients cannot provide UCs directly, informal caregivers may answer on their behalf. The collected data is stored in a database, which will become a valuable resource for decision models and further research. Users can access decision models, and personalization is possible based on the specific patient's UCs. Currently, two models have been created for the MobiGuide Project using TreeAgePro.In Figure 1b, you can see the technical components of the system. These components are predominantly built using Java technology and follow the Model-View-Controller (MVC) architectural pattern. The Java application core is connected to the presentation layer, which is based on JSP and uses Struts 1.3. The persistence layer is managed through Hibernate 3.2. To provide a richer user interaction, the system utilizes the JQuery UI JavaScript library on user-accessible pages.

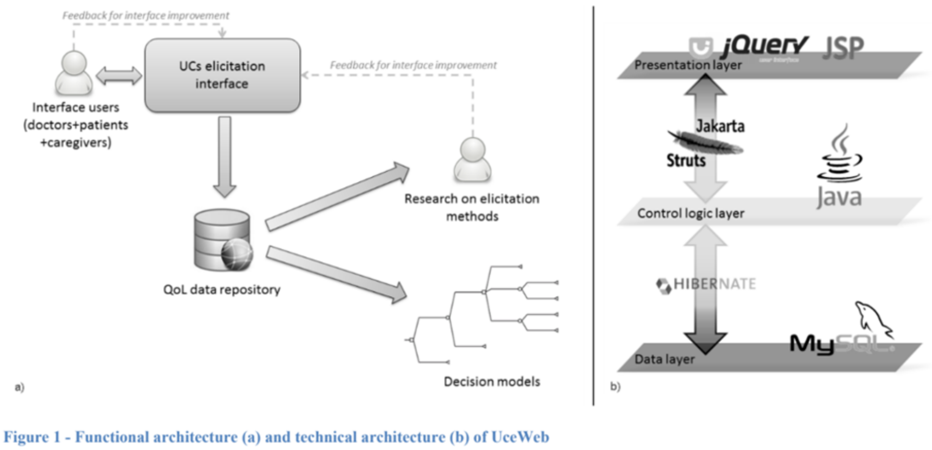


Figure 25: Software architecture diagram for Paper 1.

2.33.3 Data Parameters

The data parameters in this primarily revolve around patient-related information and utility elicitation methods. These parameters include patient attributes like age, gender, race, education, marital status, job, computer literacy, and geographical region. Importantly, these data adhere to de-identification standards to protect patient privacy. The data model also encompasses life expectancy data and utility coefficients. Additionally, the text mentions design features for handling complex utility elicitation processes, such as providing visual aids and addressing bias and anchoring effects. The data sharing aspect emphasizes the collaborative nature of UceWeb, with a focus on anonymous data while maintaining a rich patient profile for analysis purposes.

2.33.4 Datasets Used

The paper does not explicitly mention specific datasets used in UceWeb; however, it discusses the use of mortality tables sourced from national statistics institutes like ISTAT for the Italian population. It also allows non-Italian users to upload their own data with different survival statistics. The primary focus is on the collection of patient-specific information, utility coefficients, and the use of multimedia materials to aid utility elicitation. Therefore, the text does not provide details about external datasets but rather emphasizes the structure and design of the data model for utility elicitation in healthcare, particularly related to patient attributes and preferences.

2.33.5 Paper Link

Access the full paper at https://iris.unipv.it/bitstream/11571/1001388/6/UCE$_{I}RIS_{2}022_{V}QR.pdf$.

2.34 Summary of All Works

These papers review the literature on various topics related to data storage in healthcare, such as data sources, data storage, data analysis, data visualization, and data applications. It also discusses the challenges and opportunities of managing and analyzing big data using advanced technologies and algorithms. The paper aims to provide a comprehensive overview of the current state and future prospects of big data in healthcare. Additionally, the paper presents two case studies of developing web-based applications that can store, organize, analyze, and visualize patient records from different sources and diseases in a data warehouse, which can support decision-making and community diagnosing in the healthcare sector. The paper demonstrates how these applications can help uncover hidden information, compare differences between patient groups, and determine critical factors that influence disease outcomes. The papers also discuss the advantages, limitations, and future work of these approaches.

2.35 Gap Analysis

Healthcare information is sensitive data and should be kept secure. These data should be kept secure in encrypted vaults. There are rules provided by the governments for data security for medical records and databases. This issue is not addressed in most of the papers reviewed in this literature review, which may cause data breaches and possibly lead to distrust to the web-based application being developed.

2.36 Discussion and Future Planning

Common Themes and Trends:

Healthcare Data Management: Several papers focus on the challenges and opportunities related to healthcare data management. The growing volume of data in healthcare, often referred to as "big data," is a common theme. The use of data analytics, machine learning, and AI to extract valuable insights from healthcare data is also a prevalent trend.

Technology Integration: Many papers discuss the integration of advanced technologies into healthcare, such as blockchain, IoT, and artificial intelligence. These technologies are seen as having the potential to transform healthcare by improving patient care, reducing costs, and enhancing services.

Security and Privacy: Security and privacy concerns are recurring themes, especially when dealing with sensitive healthcare data. Papers address the importance of secure data storage, patient privacy, and adherence to regulations like HIPAA. Blockchain is presented as a potential solution to enhance security and transparency in healthcare.

Patient-Centric Approaches: Some papers highlight the importance of involving patients in the management of their health data. This patient-centric approach empowers individuals to control their health information and plays a role in reducing data duplication and improving data accuracy.

Interoperability: Achieving interoperability between different healthcare systems and devices is a common challenge. Standards like HL7 and FHIR are discussed as ways to facilitate data exchange and integration between healthcare applications and organizations.

Economic Impact: Several papers analyze the economic impact of technologies in healthcare, particularly the cost-effectiveness of data storage solutions. Cost-benefit analyses are suggested to help healthcare organizations make informed decisions.

Emerging Technologies: The role of emerging technologies like the Internet of Things (IoT), mobile health (mHealth), and advanced analytics is emphasized. These technologies are seen as drivers of change in healthcare.

Differences and Gaps in the Literature:

Specific Healthcare Applications: While the papers discuss healthcare data management and technology integration broadly, there is a gap in specific applications. Future research could delve into how these technologies are applied in areas like telemedicine, remote patient monitoring, or disease-specific data management.

Ethical and Legal Aspects: Although privacy and security are discussed, ethical and legal aspects of healthcare data management are not extensively covered. Future research could explore the ethical implications of data use and the legal framework surrounding healthcare data.

Real-World Implementations: Most papers provide theoretical or conceptual frameworks for technology integration. Future research should focus on real-world implementations, case studies, and the challenges encountered during actual deployments.

User Perspectives: While patient-centric approaches are mentioned, there's limited exploration of user perspectives and the acceptance of new technologies by healthcare professionals and patients. Future research could investigate the barriers to adoption and strategies for overcoming them.

Long-Term Impact: Many papers focus on short-term economic impact assessments. Long-term studies on the sustainability and societal impact of technology integration in healthcare are needed.

Potential Areas for Future Research:

Interoperability Standards: Research on the development and adoption of interoperability standards, such as FHIR, and their impact on healthcare data exchange.

Ethical AI in Healthcare: Exploration of ethical AI practices in healthcare, including transparency, bias mitigation, and fairness in decision-making.

Telemedicine and Remote Monitoring: In-depth studies on the impact of telemedicine and remote monitoring technologies on patient outcomes and healthcare costs.

User Experience and Adoption: Investigating the factors that influence the adoption of technology by healthcare professionals and patients, and designing user-friendly interfaces.

Data Governance and Ethics: Research on data governance models and ethical considerations in healthcare data management, particularly in the context of big data.

Sustainability and Scalability: Assessing the long-term sustainability and scalability of technology implementations in healthcare, with a focus on cost-effectiveness and societal benefits.

Cybersecurity in Healthcare: Research on innovative cybersecurity solutions to protect healthcare data, including blockchain applications and advanced encryption techniques.

Patient Outcomes: Studying the impact of technology integration on patient outcomes, including improved diagnosis, treatment, and overall healthcare experience.

Regulatory Compliance: Investigations into how healthcare organizations can best navigate and adhere to evolving healthcare regulations and privacy laws.

Comparative Studies: Comparative research on the performance and cost-effectiveness of different technology solutions for healthcare data management and analytics.

In conclusion, the literature shows a growing interest in the integration of advanced technologies in healthcare data management, but there is a need for more specific applications, in-depth studies, and research on ethical, legal, and user-related aspects. Future research should focus on real-world implementations and the long-term impact of these technologies on healthcare systems.

3 Problem Statement

Healthcare is an important aspect of daily life and for some affordable healthcare can be very important. A web-based application that can provide users with information and a quick comparison between different healthcare costs can be very useful for many people who seek to reduce unnecessary costs. The website will provide a user-friendly interface and an easy way to pick and compare their desired healthcare processes with their respective cost, and it will also provide a detailed graph for the changes in price from one service to the other.

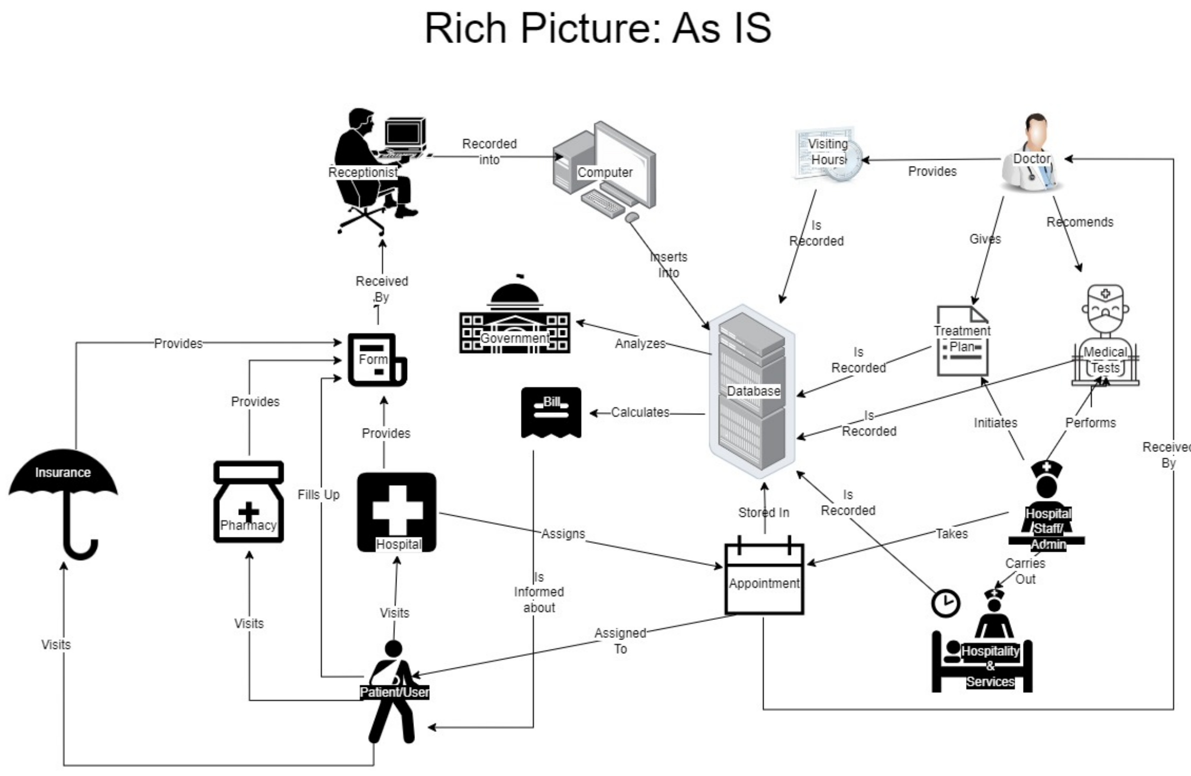
4 Methodology and Implementation

4.1 System Design

When designing a web application, it is crucial to identify the system requirements and analyze them to ensure that the system can fulfill those requirements accordingly. The design process typically involves creating a detailed plan of the system. For these types of applications, a "Rich Picture", "Entity-Relationship Diagram (ERD)", "Schema", "Normalized Schema", and a "Data Dictionary" are created before the main application for ease of operation. These artifacts help to visualize the system and its components, providing a clear understanding of the data flow and relationships between different entities. By creating these artifacts, developers can ensure that the system is designed to meet the requirements stated and that it is scalable, maintainable, and secure.

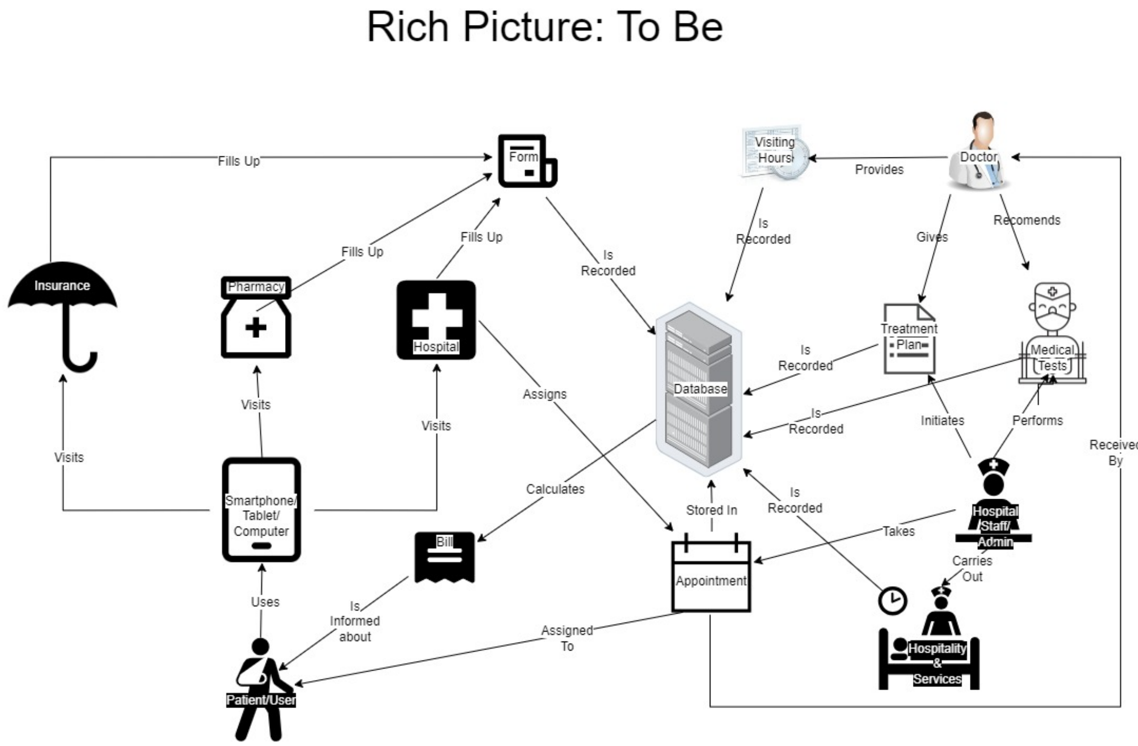
4.1.1 Rich Picture As Is

This is the Rich picture As Is. It represents an already established process of operation in the Healthcare cost analysis system. The As-Is system shows that the user visits a Hospital/Pharmacy/Insurance company and fills up a form, a Recipient then fills up the user's information on a local computer which then records these into the database.



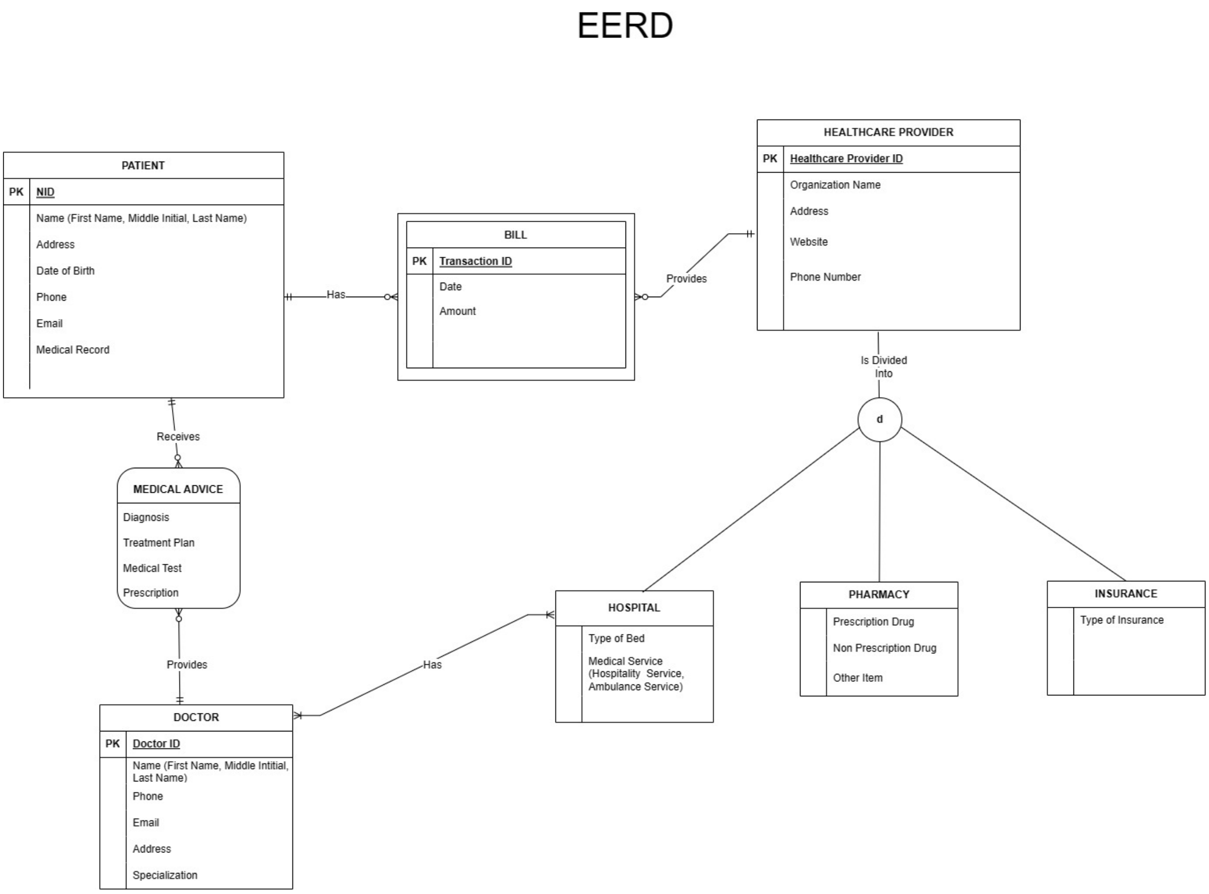
4.1.2 Rich Picture To Be

This is the Rich picture To Be. It represents the system implemented in this application. It is not drastically different from the As-Is model however, there are some crucial changes made in this model. Here, the user fills up an online form on the website developed using their Phone/Tablet/Computer. This form is directly recorded in the database.



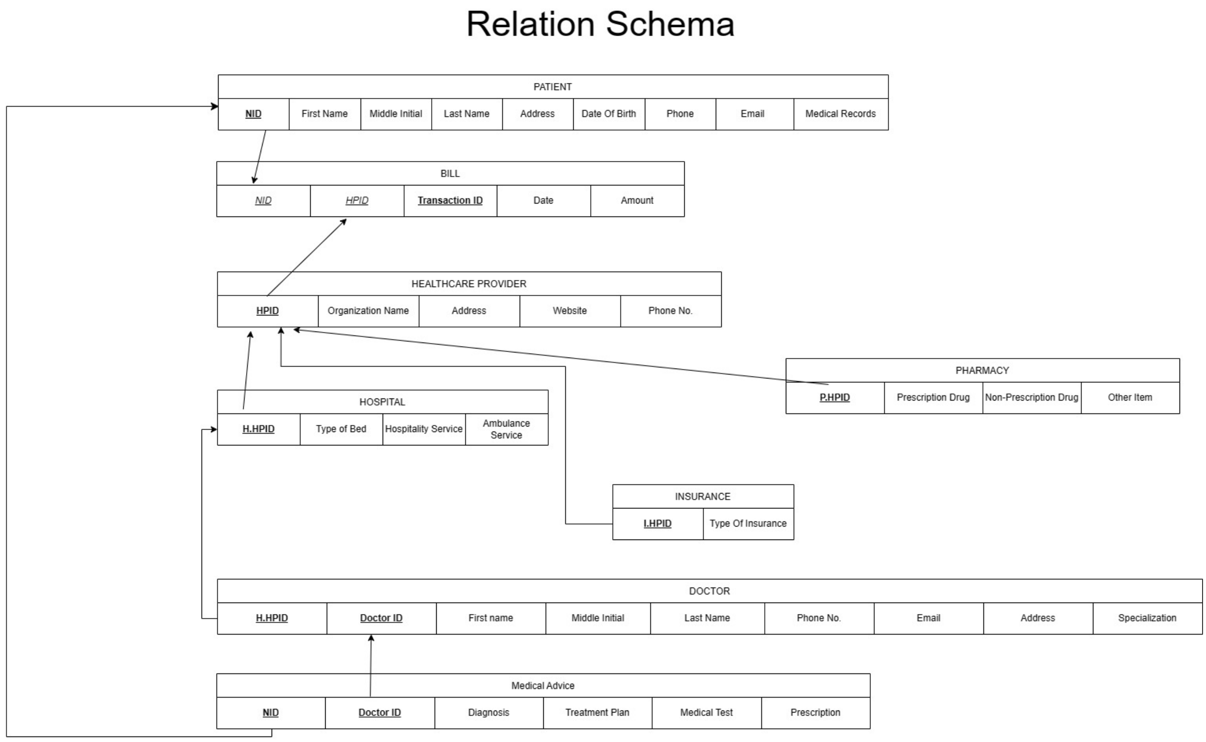
4.1.3 EERD

This is the EERD of the web-based application. Here the patient is prioritised as they are considered as the main user. A form of Bill is used to compare the cost of healthcare while three forms of healthcare namely, Hospital, Pharmacy, and Insurance are applied to be compared in this system.



4.1.4 Relational Schema

This is the Relational Schema. It is a simplified form of the EERD which helps the developers easily identify the entities and connections between them.



4.1.5 Normalization

This is Normalization or Normalized Schema. It is a more simplistic form of the Schema.

<u>Normalization:</u>

- PATIENT:
  - NID – P1
  - First Name – P2
  - Middle Initial – P3
  - Last Name - P4
  - Address – P5
  - Date of Birth – P6
  - Phone – P7
  - Email – P8
- BILL:
  - NID – P1
  - HPID – B1
  - Transaction ID – B2
  - Date – B3
  - Amount – B4
- HEALTHCARE PROVIDER:
  - HPID – B1
  - Organization Name – N1
  - Address – N2
  - Website – N3
  - Phone Number – N4
- HOSPITAL:
  - HPID – B1
  - Type of Bed – H1
  - Hospitality Service – H2
  - Ambulance Service – H3
- INSURANE:
  - I.HPID – B1
  - Type of Insurance – I1
- PHARMACY:
  - P.HPID – B1
  - Prescription Drug – A1
  - Non Prescription Drug – A2
  - Other Item – A3
- DOCTOR:
  - H.PID – B1
  - Doctor ID – D1
  - First Name – D2
  - Middle Initial – D3
  - Last Name – D4
  - Phone no. – D5
  - Email – D6
  - Address – D7
  - Specialization – D8
- MEDICAL ADVICE:
  - NID – P1
  - Doctor ID – D1
  - Diagnosis – M1
  - Treatment Plan – M2
  - Medical Test – M3
  - Prescription – M4

Functional Dependencies:

P1 -> P2, P3, P4, P5, P6, P7
P1, B1, B2 -> B3, B4
B1 -> N1, N2, N3, N4
B1 -> H1, H2, H3
B1 -> I1
B1 -> A1, A2, A3
B1, D1 -> D2, D3, D4, D5, D6, D7, D8
P1, D1 -> M1, M2, M3, M4

1NF:

P1	P2	P3	P4	P5	P6	P7	**B1**	**B2**	B3	B4
N1	N2	N3	N4	H1	H2	H3	I1	A1	A2	A3
D1	D2	D3	D4	D5	D6	D7	D8	M1	M2	M3
M4										

2NF:

P1	P2	P3	P4	P5	P6	P7

B1	N1	N2	N3	N4	H1	H2	H3	I1	A1	A2
A3										

P1	**D1**	**B1**	M1	M2	M3	M4	D2	D3	D4	D5
D6	D7	D8								

P1	**B1**	**B2**	B3	B4

P1	**B1**	**B2**	**D1**

3NF:

The above relations are already in 3NF.

BCNF:

The above relations are already in BCNF.

4.1.6 Data Dictionary

This is a Data Dictionary. It helps provide information about the attributes and characteristics of the entities introduced in the EERD.

PATIENT

Name	Data Type	Size	Remarks
NID	INTEGER	11	National ID of the patient. E.g: “1009283779”
First Name	VARCHAR	50	First Name of the Patient. E.g: “Mohammed”
Middle Initial	VARCHAR	50	Middle Name of the Patient. E.g: “Sakibul”
Last Name	VARCHAR	50	First Name of the Patient. E.g: “Islam”
Address	VARCHAR	255	Home Address of the Patient. E.g: “Block-B, Bashundhara R/A, Dhaka”
Date of Birth	DATE		Date Of Birth Of the Patient. E.g: “11/11/1998”
Phone	VARCHAR	20	Contact Number of the Patient. E.g: “01977663896”
Email	VARCHAR	50	Email Address of the Patient. E.g: “mdsakibulislam@gmail.com”
Medical Record	TEXT		Detailed medical record of the patient.E.g:”This patient is diagnosed with a brain tumor.”

BILL

Name	Data Type	Size	Remarks
Transaction ID	INTEGER	11	Unique identifier for the bill transaction.E.g: “129067”
Date	DATE		Date when the bill was generated.E.g: “24/11/2021”
Amount	DECIMAL		The total amount of the bill.E.g: “12,000.50”

HEALTHCARE PROVIDER

Name	Data Type	Size	Remarks
Healthcare Provider ID	INTEGER	11	Unique identifier for the healthcare provider.E.g: “34576”
Organization Name	VARCHAR	255	Name of the healthcare provider organization.E.g: “Evercare Hospital”
Address	VARCHAR	255	Address of the healthcare provider.E.g: “Block-A, Bashundhara R/A, Dhaka”
Website	VARCHAR	255	Website URL of the healthcare provider.E.g: “www.evercarebd.com”
Phone Number	VARCHAR	20	Phone number of the healthcare provider.E.g: “01766332589”

MEDICAL ADVICE

Name	Data Type	Size	Remarks
Diagnosis	TEXT		The diagnosis provided by the doctor.E.g: “Need to undergo surgery within next 3 months”
Treatment Plan	TEXT		The treatment plan recommended by the doctor.E.g: “First 2 months take XYZ medicine and the 3rd Month need to increase medicine dosage before surgery.”
Medical Test	TEXT		Any medical tests recommended by the doctor.E.g:”Take Blood Test and X-Ray.”
Prescription	TEXT		Details of any prescribed medications.E.g:”Take XYZ medicine thrice daily after meal.”

DOCTOR

Name	Data Type	Size	Remarks
Doctor ID	INTEGER	11	Unique identifier for the doctor.E.g: “3458”
First Name	VARCHAR	50	First Name of the Doctor. E.g:”Syeda”
Middle Initial	VARCHAR	50	Middle Name of the Doctor. E.g:”Afroza”
Last Name	VARCHAR	50	Last Name of the Doctor. E.g:”Begum”
Phone	VARCHAR	20	Contact number of the doctor.E.g: “01636926785”
Email	VARCHAR	50	Email address of the doctor.E.g: “syedaab@gmail.com”
Address	VARCHAR	255	Address of the doctor.E.g: “Mirpur, Dhaka”
Specialization	VARCHAR	50	The medical specialization of the doctor.E.g: “MBBS”

HOSPITAL

Name	Data Type	Size	Remarks
Type of Bed	VARCHAR	50	Type of beds available in the hospital.
Hospitality Service	VARCHAR	255	Types of medical services provided by the hospital.
Ambulance Service	VARCHAR	255	Types of medical services provided by the hospital.

PHARMACY

Name	Data Type	Size	Remarks
Prescription Drug	VARCHAR	255	Prescription drugs available at the pharmacy.
Non Prescription Drug	VARCHAR	255	Non-prescription drugs available at the pharmacy.
Other Item	VARCHAR	255	Other items available at the pharmacy.

INSURANCE

Name	Data Type	Size	Remarks
Type of Insurance	VARCHAR	255	Type of Insurance provided by the health provider.

4.2 Software Architecture

4.2.1 Softwares Used

The system implemented is primarily a web-based system. To make this web-based application a combination of HTML, CSS, PHP and Javascript code is used. To run these codes properly, Microsoft Visual Studios Code application is used as the primary compiler. To implement the web-based components Live server and Default Web Dev setting with extension are used. The website connects to a back-end server with the aid of a local server using the software phpMyAdmin.

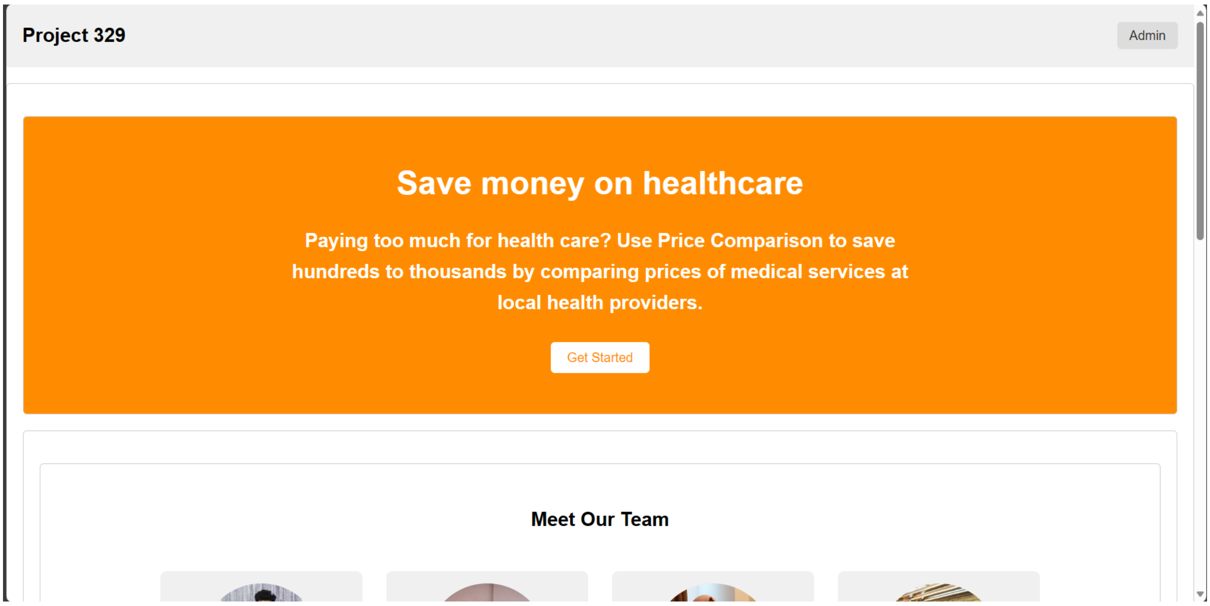
4.2.2 Data Collection and Analysis

Data was collected from multiple sources, primarily from Hospitals. Local hospitals were visited and consulted with for data however, since healthcare data is sensitive it was very hard to collect data directly from hospitals. So other sources were used like online and insiders from the hospital in question. The collected data was sorted and stored in a local server by the team members. Each data was categorized by their provider type, for example, medicine was listed under Pharmacy while ECG test was listed under Hospital.

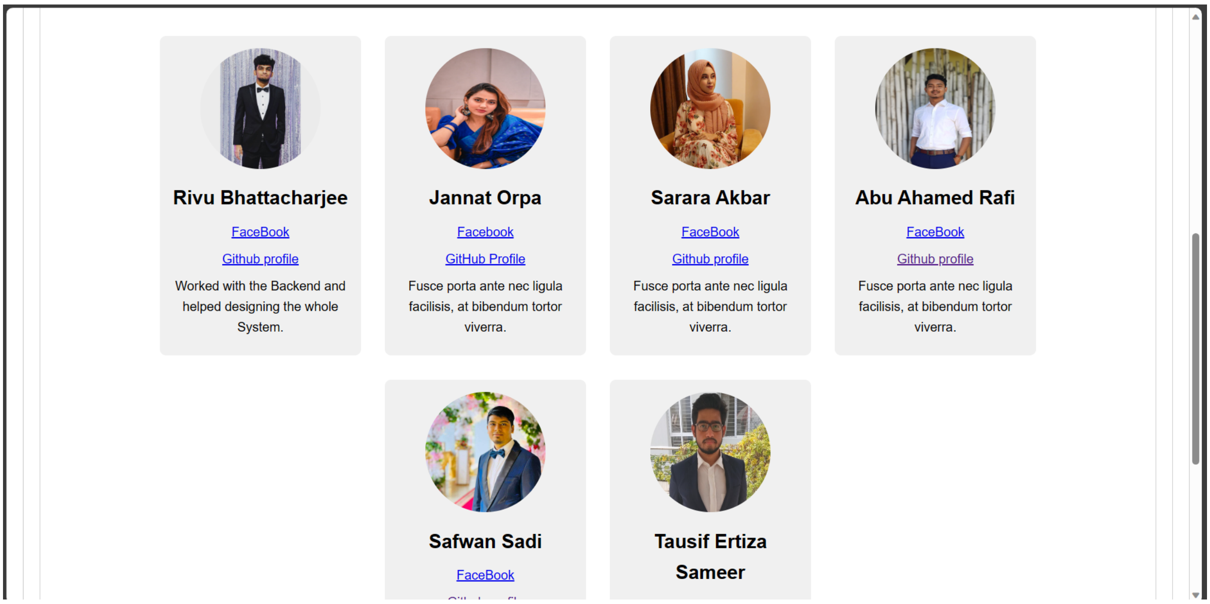
4.2.3 Interface Design and Implementation

Landing Page

The application starts when a user loads the website through their browser. When the page is loaded the user finds themselves on the Landing Page of the website. Here they are greeted with the message "Save money on healthcare", which discusses how they can save money on healthcare using this application. A button "Get Started will take them to a page where they can compare the prices of healthcare services. Another button "Admin" located on the top of the page will take the user to the Admins page where the page operators can log in and input or edit data to the database.

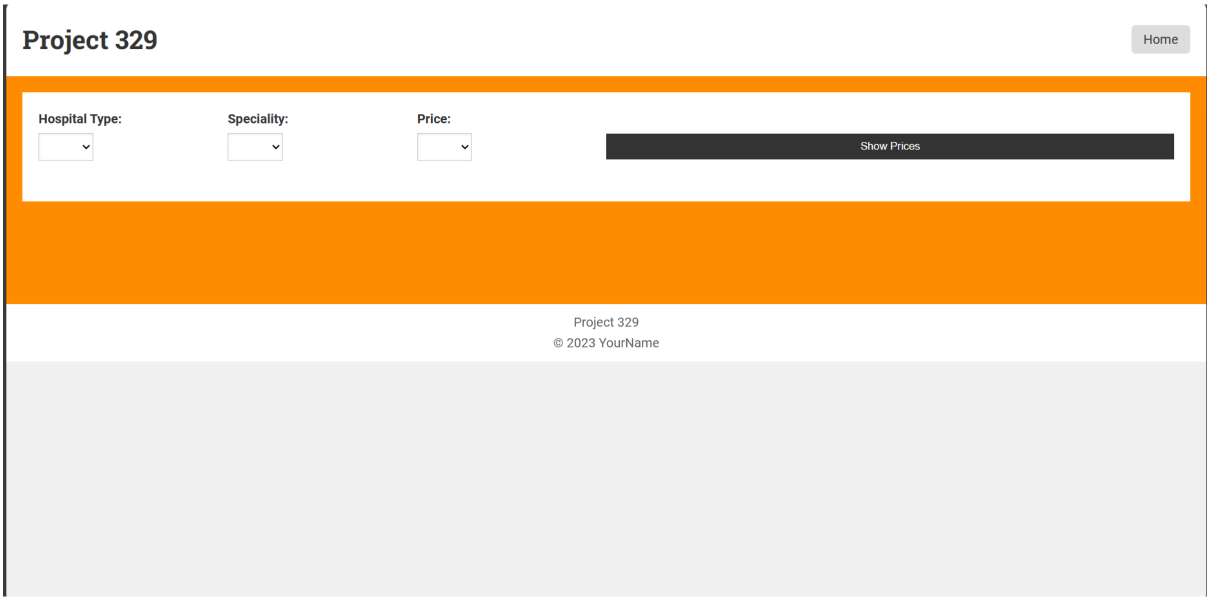


If the viewer scrolls on the landing page they will find a section titled "Meet Our Team". Here, they can find a brief introduction to every member of the team along with a picture of them and links to their social profiles.



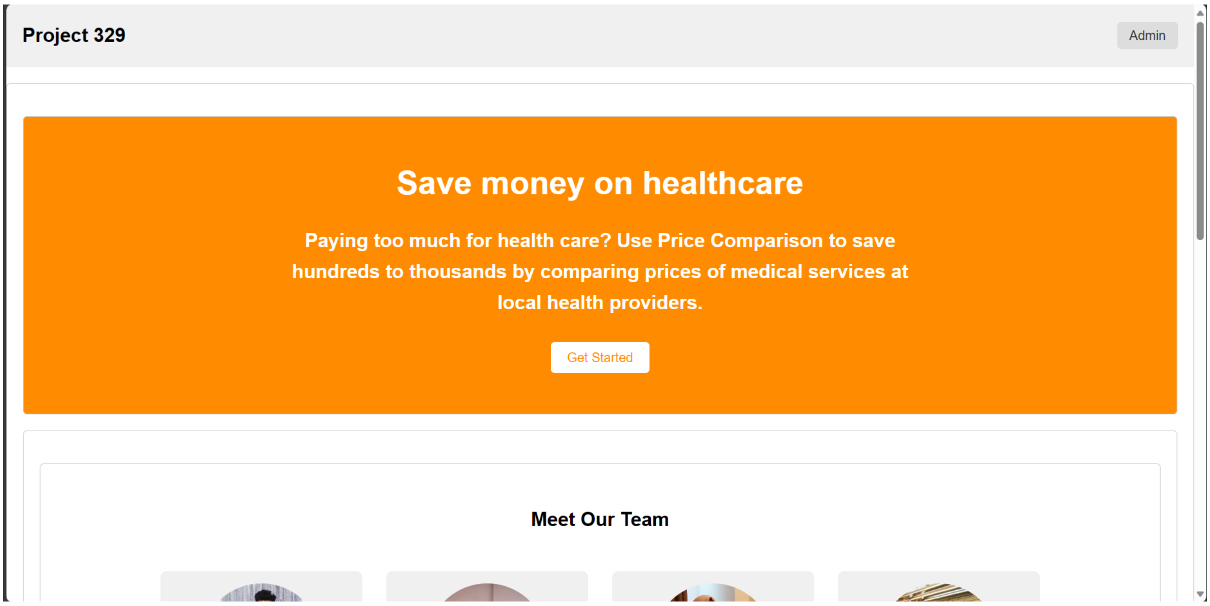
Comparison Page

When the "Get Started" button is pressed from the Landing Page the user will be redirected to the comparison page. Here the user can select two items from the two combo-box. When two items are selected their consecutive prices will be presented to the user below the selection combo-box. This is a simple and easy process for the user to find and compare desired healthcare prices. A "Home" button on the top right corner will take the user back to the Landing page when clicked.



Landing Page Code

Here is the Dashboard of the application.



The code for the first section along with the button is as follows:

```html
<section>
    <section class="first-section">
        <div class="container">
            <h1>Save money on healthcare</h1>
            <h2>Paying too much for health care? Use Price Comparison to save hundreds to thousands by comparing prices of medical service
            <button id="getStartedBtn">Get Started</button>
        </div>
</section>
```

The code for the admin button contains:

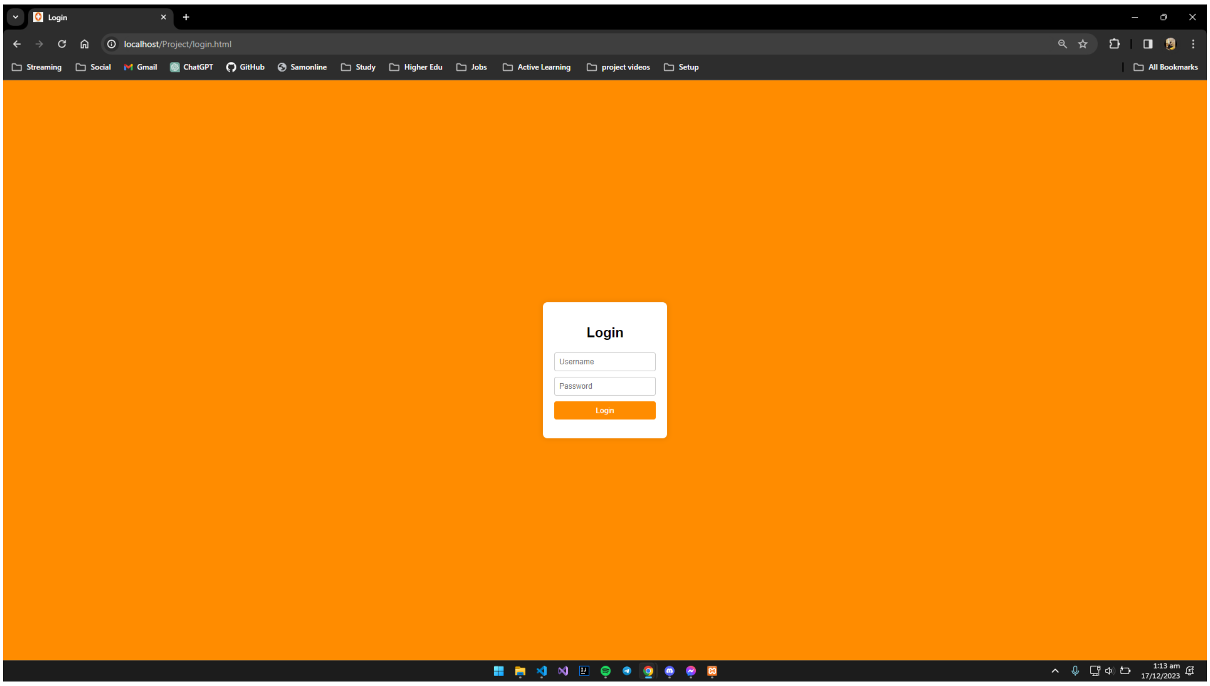
```html
<header>
    <div class="logo">
        Project 329
    </div>
    <nav>
        <ul>
            <li><a href="/admin">Admin</a></li>
        </ul>
    </nav>
</header>
```

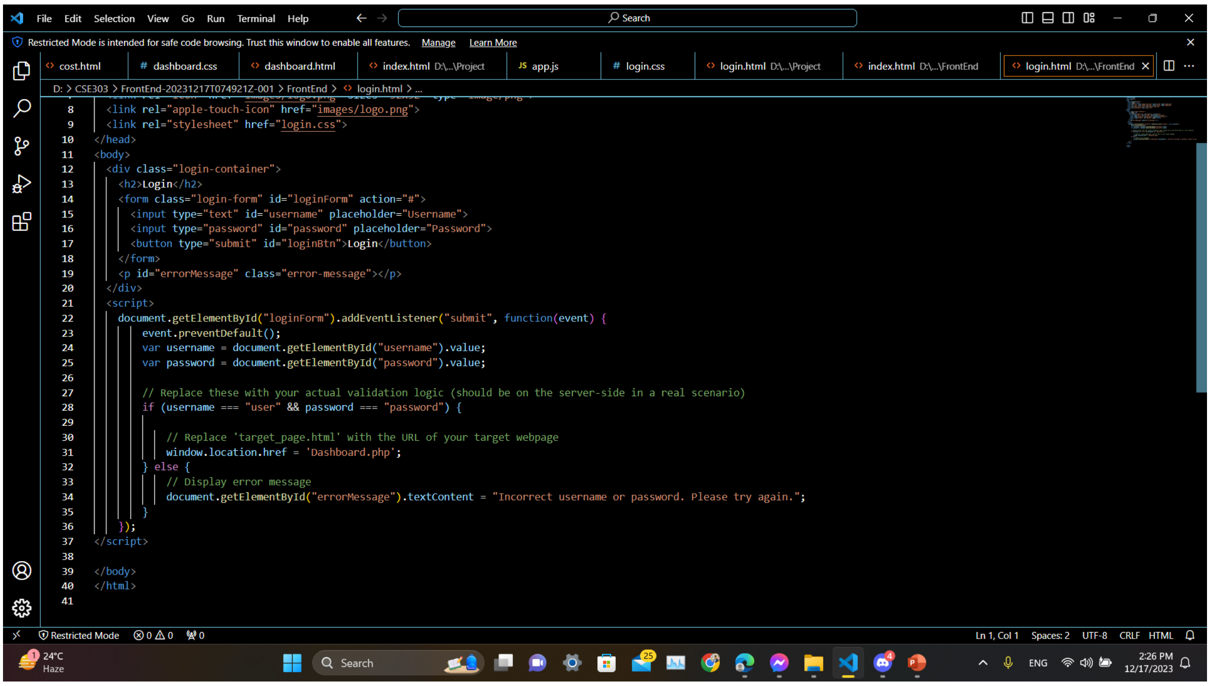
For the Team Members section the codes are as follows:

```html
<section>
    <section class="second-section">
        <h2>Meet Our Team</h2>
        <div class="team-members">
            <div class="team-member">
                <img src="images/Rivu.jpg" alt="Team Member 0">
                <h3>Rivu Bhattacharjee</h3>
                <p>Lorem ipsum dolor sit amet, consectetur adipiscing elit.</p>
                <p>Nulla convallis libero et nisi consectetur, et malesuada neque.</p>
                <p>Fusce porta ante nec ligula facilisis, at bibendum tortor viverra.</p>
            </div>

            <div class="team-member">
                <img src="images/Orpa.jpg" alt="Team Member 1">
                <h3>Jannat Orpa</h3>
                <p>Lorem ipsum dolor sit amet, consectetur adipiscing elit.</p>
                <p>Nulla convallis libero et nisi consectetur, et malesuada neque.</p>
                <p>Fusce porta ante nec ligula facilisis, at bibendum tortor viverra.</p>
            </div>
            <div class="team-member">
                <img src="images/Sarara.jpg" alt="Team Member 2">
                <h3>Sarara Akber</h3>
                <p>Lorem ipsum dolor sit amet, consectetur adipiscing elit.</p>
                <p>Nulla convallis libero et nisi consectetur, et malesuada neque.</p>
                <p>Fusce porta ante nec ligula facilisis, at bibendum tortor viverra.</p>
            </div>

            <div class="team-member">
                <img src="images/Rafi.jpg" alt="Team Member 3">
                <h3>Abu Ahamed Rafi</h3>
                <p>Lorem ipsum dolor sit amet, consectetur adipiscing elit.</p>
                <p>Nulla convallis libero et nisi consectetur, et malesuada neque.</p>
                <p>Fusce porta ante nec ligula facilisis, at bibendum tortor viverra.</p>
            </div>

            <div class="team-member">
                <img src="images/Sadi.jpg" alt="Team Member 4">
                <h3>Safwan Sadi</h3>
                <p>Lorem ipsum dolor sit amet, consectetur adipiscing elit.</p>
                <p>Nulla convallis libero et nisi consectetur, et malesuada neque.</p>
                <p>Fusce porta ante nec ligula facilisis, at bibendum tortor viverra.</p>
            </div>

            <div class="team-member">
                <img src="team-member5.jpg" alt="Team Member 5">
                <h3>Towsif</h3>
                <p>Lorem ipsum dolor sit amet, consectetur adipiscing elit.</p>
                <p>Nulla convallis libero et nisi consectetur, et malesuada neque.</p>
                <p>Fusce porta ante nec ligula facilisis, at bibendum tortor viverra.</p>
            </div>
        </div>
</section>
```

Admin Page Login

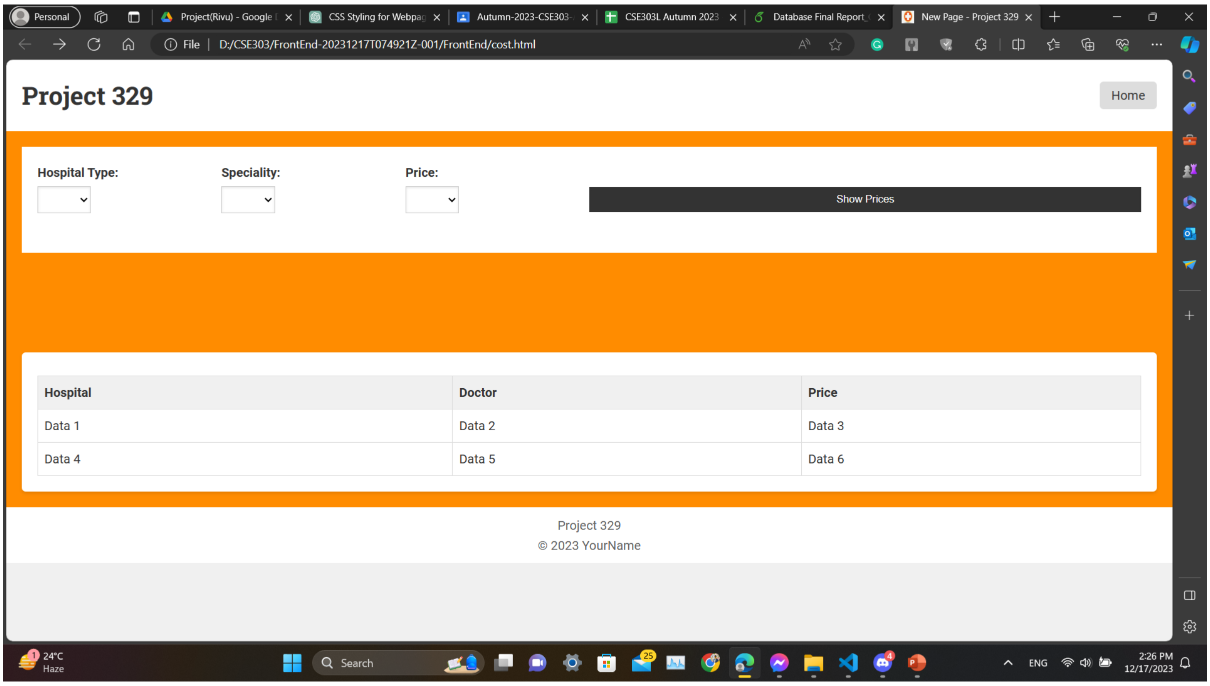
This page lets the admin of the website login into their profile and input data. The code for this page is shown below:

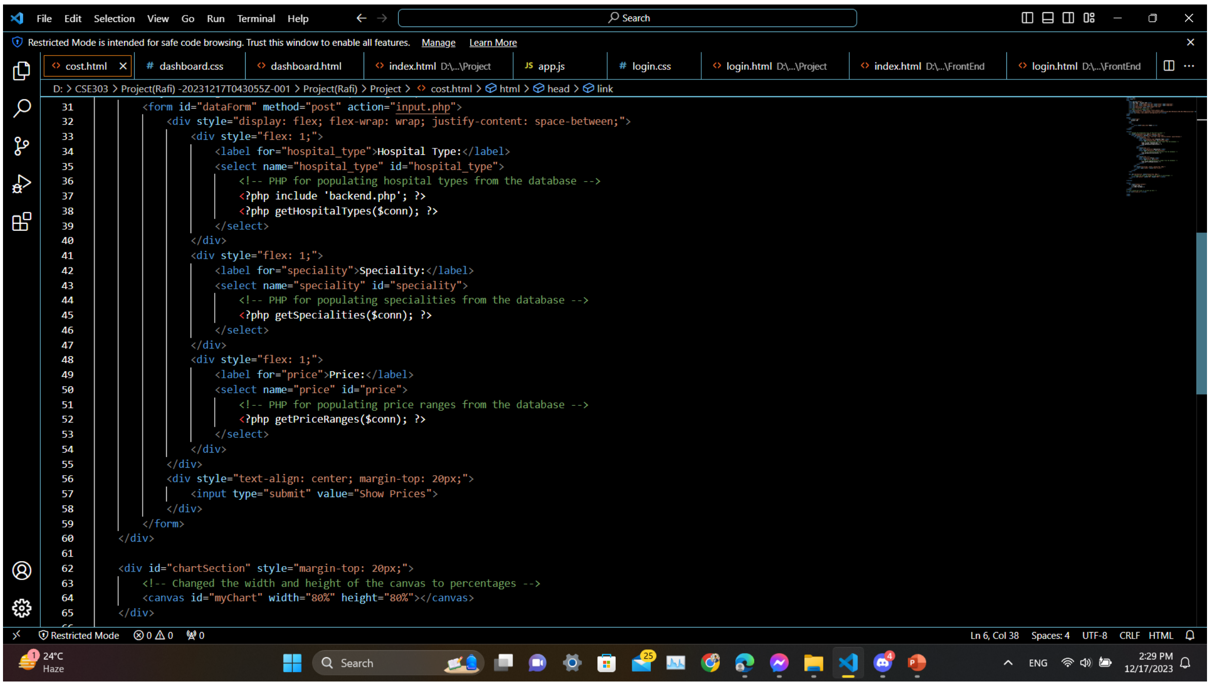




Code for Comparison Page

Here is the page where components from healthcare data can be compared. To compare two items they have to be loaded, it is achieved by using two combo-boxes, each selecting an item from the Healthcare database and then compared. The code provided shows how it is done.





4.2.4 Back-end Integration

The data collected is stored in the back-end of the application. A local server is used to store the data and later the data is fetched to the front-end of the application.

The code below represents the code used to connect the back-end to the back-end:

C: > xampp > htdocs > HealthCare > database.php > ...

```php
<?php

$db_server = "localhost";
$db_user = "root";
$db_pass = "";
$db_name = "healthcaredb";
$connection = "";

try{
    $connection = mysqli_connect($db_server,$db_user,$db_pass,$db_name);
}
catch(mysqli_sql_exception){
    echo "Could not connect <br>";
}

if($connection){
    echo "You are connected! <br>";
}
else{
    echo "Connection failed :(( <br>";
}
?>
```

```php
<?php

    if($_SERVER["REQUEST_METHOD"] == "POST"){

        $Item = filter_input(INPUT_POST, "Item", FILTER_SANITIZE_SPECIAL_CHARS);
        $Cost = filter_input(INPUT_POST, "Cost", FILTER_SANITIZE_SPECIAL_CHARS);

        if(empty($Item)){
            echo"Please enter an Item$Item";
        }
        elseif(empty($Cost)){
            echo"Please enter a Cost$Cost";
        }
        else{
            $sql = "INSERT INTO Bill (Item, Cost)
                    VALUES ('$Item', '$Cost')";

            try{
                mysqli_query($connection, $sql);
                echo"Item is Registered!";
            }
            catch(mysqli_sql_exception){
                echo"That Item$Item is taken or Item could not be registered";
            }
        }
    }

    mysqli_close($connection);
?>
```

```php
// Function to get hospital types
function getHospitalTypes($conn) {
    $sql = "SELECT DISTINCT hospital_type FROM hospitals";
    $result = $conn->query($sql);

    if ($result->num_rows > 0) {
        while($row = $result->fetch_assoc()) {
            echo "<option value='" . $row["hospital_type"] . "'>" . $row["hospital_type"] . "</option>";
        }
    }
}

// Function to get specialities
function getSpecialities($conn) {
    $sql = "SELECT DISTINCT speciality FROM hospitals";
    $result = $conn->query($sql);

    if ($result->num_rows > 0) {
        while($row = $result->fetch_assoc()) {
            echo "<option value='" . $row["speciality"] . "'>" . $row["speciality"] . "</option>";
        }
    }
}
```

5 Result Analysis

5.1 Economical Sustainability

The economic analysis of our healthcare cost comparison web application reveals promising results. By enabling users to compare prices across different healthcare services, we contribute to economic sustainability by empowering individuals to make informed decisions about their healthcare expenses. The cost-effectiveness of healthcare services is crucial for both consumers and the overall healthcare system. Our data indicates a positive impact on reducing out-of-pocket expenses for users, fostering economic sustainability in the healthcare sector.

5.2 Environmental Sustainability

While the primary focus of our application is on economic factors, it indirectly contributes to environmental sustainability. By facilitating efficient comparison and decision-making in healthcare, users can potentially reduce unnecessary visits, paperwork, and resource-intensive processes. The shift towards digital healthcare comparison and decision support aligns with broader efforts to minimize the environmental footprint of the healthcare industry. Although the impact may be indirect, promoting digital solutions is a step towards a more environmentally sustainable approach to healthcare services.

5.3 Social Sustainability

The social aspect of sustainability is addressed through improved accessibility and affordability of healthcare. Our application promotes social sustainability by providing a platform where users can access and compare healthcare prices easily. This accessibility ensures that a broader segment of the population can make informed choices about their healthcare, reducing disparities in healthcare access. Additionally, the potential cost savings contribute to overall social well-being by easing the financial burden on individuals and families, fostering a more sustainable and equitable healthcare system.

6 Problem Analysis

One of the key concerns when storing healthcare data is data security. Healthcare data is sensitive and can be of high risk if leaked or stolen. A limitation of this website is the security concern. As we are not highly equipped to provide secure servers and have no connection to government agencies it is not possible to provide higher security to the website users.

7 Conclusion

In this paper, we have presented the design and implementation of a web-based application that allows users to compare healthcare prices across different services. We also discussed the sustainability aspects of our application, covering the economic, environmental, and social dimensions. We demonstrated how our application contributes to economic sustainability by enabling users to make cost-effective decisions about their healthcare expenses. We also showed how our application indirectly supports environmental sustainability by facilitating digital healthcare comparison and reducing unnecessary resource consumption. Finally, we highlighted how our application enhances social sustainability by improving the accessibility and affordability of healthcare services, reducing disparities, and promoting social well-being. Our application is a novel and useful tool for healthcare consumers, providers, and policymakers, as it offers a simple and efficient way to compare healthcare prices and foster a more sustainable healthcare system.

References

[1] B. M. B. V. Laporti, V., “Athena,” *Computers in Industry*, vol. 60, no. 6, p. 367–38, 2009.

[2] M. V. B. A. Rossi L, Margola L, “whospital: a web-based application with digital signature for drugs dispensing management,” in *Proceedings of the 28th annual international conference of the IEEE (EMBS’2006)*. IEEE, 2006, p. 6793–6796.

[3] M. E. L. H. P. D. C. T. C. Lane, N.D., “A survey of mobile phone sensing,” *IEEE Communication Magazine*, vol. 48, no. 9, p. 140–150, 2010.

[4] P. B. G. D. A. P. C. GPitsillides A, Samaras G, “E. virtual collaborative healthcare teams for home healthcare,” in *pecial issue on Advanced Mobile Technologies for Health Care Applications*. J Mobile Multimedia, 2006, pp. 23–36.

[5] F. R. Berners-Lee, T. and L. Masinter, “Medical internet of things and big data in healthcare,” *The Internet Society*, pp. 156–163, 2005. [Online]. Available: http://tools.ietf.org/html/rfc3986.

[6] e. a. Singh John Leon, Hanson, “Mobile health apps that help with covid-19 management: scoping review,” *JMIR Nurs*, vol. 3., 2020.

[7] S. L. Erevelles S, Fukawa N, “Big data consumer analytics and the transformation of marketing.” *J Bus Res*, vol. 69, p. 897–904, 2016.

[8] M. N. . A.-J. J. AbuKhousa, E., “e-health cloud:opportunities and challenges,” *Future Internet*, vol. 4, pp. 621–645, 2012.

[9] K. T. M.]Anjum, A.; Soomro, “Towards cloud based big data analytics for smart future cities.” *J. Cloud Comput*, vol. 4, no. 3, p. 49–11, 2015.

[10] A. MJ, “Next generation networking: distributed multimedia information for healthcare,” *Multimed Tools Appl*, vol. 33, no. 1, pp. 5–11, 2007.

[11] B. C, “Big data and analytics key to accountable care success,” *Framingham: IDC Health Insights*, 2012.

[12] D. V. Dimitrov, “Medical internet of things and big data in healthcare,” *Healthc. Inform. Res*, vol. 22, no. 3, pp. 156–163, 2016. [Online]. Available: https://ieeexplore.ieee.org/abstract/document/9254291?fbclid=IwAR1re2AFXHiFChMIVPY4TApg-VAxSgGr7CYYgvb-f61Z7jPqziXTVngJHI

[13] S. M. V. De Gucht, “Adriaenssens,” 2020. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S0165032720323806?fbclid=IwAR1ZdpMmR842DBhQrLMUnG7e2x_D0BQOcSbspI_fwm5lm1ZgXdFqxGCkslI

[14] M. Yuce, “Implementation of wireless body area networks for healthcare systems,” *An evaluation framework for health information systems: human, organization and technology-fit factors*, 2010. [Online]. Available: https://www.sciencedirect.com/science/article/abs/pii/S1389128619302695?fbclid=IwAR2JtaQFUAkkAci5DTqT55OuyH0dXSI5MgRidd0vk1JaKyQuqd3tzRovDPc#preview-section-abstractI

[15] Z. Y.-V. A. K. S. Qadri YA, Nauman A, "The future of healthcare internet of things: a survey of emerging technologies," *IEEE Commun Surv*, vol. 22, no. 2, p. 1121–1167, 2020. [Online]. Available: https://link.springer.com/article/10.1007/s40747-021-00582-9

[16] "Agency for healthcare research and quality," in *Medical Algorithms*. IEEE, 2011. [Online]. Available: https://innovations.ahrq.gov/qualitytools/medalorg-medical-algorithms

[17] L. D., "3d data management: controlling data volume, velocity, and variety, application delivery strategies," *Stamford: META Group Inc*, 2001. [Online]. Available: Bigdatainhealthcare:management,analysisandfutureprospects|JournalofBigData|FullText(springeropen.com)

[18] S. Ahmed, "Byod, personal area networks (pans) and iot: Threats to patients privacy." *arXiv preprint arXiv*, 2019. [Online]. Available: https://www.researchgate.net/publication/344152133_Online_Storage_in_Healthcare_Organizations/references

[19] D. V. Dimitrov, "American health information management association," *What is Health Information?* [Online]. Available: http://www.ahima.org/careers/healthinfo

[20] A. B. S. A. . G. A. S. Abubakar A., Aliyu, "Building a diabetes data warehouse to support decision making in healthcare industry," vol. 16, no. 2, p. 138–143, 2014. [Online]. Available: (1)(PDF) DATAWAREHOUSEFORMININGANDSIMULATINGMEDICALRECORDS(researchgate.net)

[21] . H. J. Hana, R.E., "Design and implementation of online conference management system,," *International Journal of Scientific Engineering Research,*, vol. 6, no. 3, pp. 1195–1200, 2016. [Online]. Available: (1)(PDF)AnApplicationofWeb-basedE-HealthcareManagementSystemUsingASP.Net(researchgate.net)

[22] "Global strategy for the diagnosis, management and prevention of copd,," *Global Initiative for Chronic Obstructive Lung Disease (GOLD)*, 2013. [Online]. Available: www.goldcopd.org/uploads/users/files/GOLD_Report_2013_Feb20.pdf

[23] "A secure xml based synchronization scheme for mobile devices," *Masters Thesis,Dept of Computer Science, University of Cyprus*, 2006. [Online]. Available: site:http://aglets.trl.ibm.co.jp

[24] M. D. I. Hopkinton, "The digital universe driving data growth in healthcare," 2018. [Online]. Available: https://www.emc.com/analyst-report/digital-universe-healthcare-vertical-report-ar.pdf

[25] D. G. F. Marthe R. Gold, David Stevenson, "Similarities and differences in summary measures ofpopulation health," *Healthc. Inform. Res*, vol. 23, no. 3, p. 115–34, 2002. [Online]. Available: https://iris.unipv.it/bitstream/11571/1001388/6/UCE_IRIS_2022_VQR.pdf