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Big Data of Patients in E-Health Care Service

Ukwosah, Ernest Chukwuka
Department of Computer Science, Federal University Wukari, Taraba State, Nigeria | E-mail: eukwosah@gmail.com, ukwosah@fuwukari.edu.ng

Abstract: *This work describe the broad design of patients' big data in e-health care service and the benefits of an e-health care system, which implements integration strategies and suitable technologies that will handle the interoperability problem among its essential agents. Intelligent agents play a critical role in providing correct information for diagnostic, treatment, timely update and so on. They present work on behalf of human agents taking care of routine tasks, thus increasing speed and reliability of the information exchanges.*

Keywords*: Big data of patients, e-health care service*

Introduction

Big data is a collection of large and complex data sets which are difficult to process using common database management tools or traditional data processing applications. Big data refers to the tools, processes and procedures allowing an organization to create, manipulate and manage very large data sets and storage facilities. Big data technologies will resolve complex health care data analytics in different perceptive to answer what happen to patients, diagnostic to answer the reason why it happened, predictive to understand what will happen and prescriptive to detect how we can make it happen. The big data will improve patients medical care decision making, lower costs and saves life.

Health care services manages huge amount of data that stores relevant details of information about patients. These data cannot be handle efficiently in the manual process. Automation is essential to effectively manipulate large amount of patients' details electronically. Big data in health care services are large and complex which are complex to manage using existing software and database technologies. Patients' big data comprises the data from physician's notes, administrative data, medical imaging, insurance, prescription of drugs, patients' records, twitter feeds, social media, blogs and so on.

Big data technologies in health care services need adequate research attention, especially relating to the necessity of patients information management, where medical history is a vital issue. The manual record keeping and its management will be tedious as it concerns the voluminous data of patients, the velocity to manage information, its variety and veracity to deduct outcome of prescription and medication of patient through stored structured and unstructured data of patients. The challenging of capturing, storing, searching, sharing, analysing and securing electronic health record (HER) of patients and patients having access to their individual medical records and as well be able to consult Doctors online. A robust big data of patients will make easy access to consult a doctor, run prescribe laboratory tests, and remind patients for routine check-up and medication, predictive analysis of future health status and providing preventive measures to chronic diseases on time.

Statement of Problem

Many patients suffer from chronic sickness disease or sickness owe to having a unique medical history records. It will be difficult to relate present medical examination and previous medication and kind of sickness previously encountered. Patients having different medical records that are store manually either in a particular hospital or different hospital. Big data of patients' medical record will be better system to harmonise their records.

Motivation

The need for patients to have adequate and earlier information pertaining their health status at all time is worth acknowledging. It will help to administer patients quick and earlier medication for such abnormality or predictive occurrence observed in his or her health status. The patients as well can note and be updated of his or her future health status, and seek for earlier preventive measure to subside or avoid future chronic diseases that are dangerous to one's health, which might cost life if not detected or ignore.

Aim of the Research

The use of big data to achieve robust, reliable and correct information management in diagnosing and treatment of patients, and having timely update of their medical record online.

Objectives of study

1. Maintain overall operations and increase efficiency of hospitals
2. Maintain patient satisfaction index through quality health care services
3. Consolidated patient electronic management record made readily available at any of time
4. Efficient management of resources like manpower, machine and space

Significance of study

The prosed paper dealt with the study of patients' information management system in the health care services sector. It will be relevant to guide patients on their health status, to take earlier responds to their health issues, avoiding critical situations of ugly health status that can deteriorate and even kill patients suffering chronic diseases.

Scope and limitations of study

This research take into account the benefits of big data in health service sector as it concerns patients' electronic medical records, the necessity for emerging to the new evolving systems that can handle and manipulate patients information records as it only concerns to their medical history records to predict outcomes of results, prescribe medication adequately and have access to medical records for timely guidance, avoidance and reminder for medical check-up on their health status. The limitation of this paper does not give cognizance to detail development of big data of a particular hospital or health care centre.

Methodology

A critical review of online software and journal papers that survey the development of big data in health services. Then online questionnaire to survey date from people online to analyse the need for patients to have sufficient information about their electronic health records.

Review of related Literature

Big Data is transforming healthcare, business, and ultimately society itself, as e-Health becomes one of key driving factors during the innovation process. Thorough investigation on BDeHS (Big Data e-Health Service) to fulfil the Big Data applications in the e-Health service domain. The paper explain why the existing Big Data technologies such as Hadoop, MapReduce, STORM and the like cannot be simply applied to e-Health services directly. Focuses on additional capabilities as required in order to make Big Data services for e-Health become practical. Further, the report of the design of the BDeHS architecture that supplies data operation management capabilities, regulatory compliance, and e-Health meaningful usages [1].

Providing healthcare services and other related services through e-healthcare, is an evolving phenomenon. To successfully implement e-healthcare strategy, a careful study of consumers' information needs is crucial. The survey research, sought opinions on the importance of various features. Our findings indicate that consumers view features related to consumer self-education via an e-healthcare web site as most important, followed by features related to efficiency. Improved communications and timely services, with no statistically significant differences between the two, are both viewed as less important features than efficiency. Self-diagnosis and self-test tools come in the preference list. Given the proliferation of online healthcare information in general, the high importance given by participants of features related self-education calls for involvement of healthcare providers in certifying, endorsing, or providing quality healthcare information [2].

Growing communications industry, telecommunications and Informatics, the globe will encounter new revolution every day. Information and communication technologies Revolution have significant effects in all parts of economic, social, political and national security. One of the most important areas of application of information technology, health care field is in this research using library methods and especially using of databases Plumbed, Cochrane, Embase and the Search engines [3].

The availability of data from these fields are enormous which needs terabytes and zettabyte of storage is required to store the files and need an efficient method to access those files efficiently with degradable system performance. Big data is an emerging field which is used to store centralized semi structured and unstructured data [4].

The concept of big data is now treated from different points of view covering its implications in many fields remarkably including healthcare. To achieve the wealth of health information, integrating, sharing and availing data are the essential tasks that ultimately demand the concept of distributed system. However, privacy and security of data are the matter of concern, as data need to be accessed from various locations in the distributed system [5].

The rapidly expanding field of big data analytics has started to play a pivotal role in the evolution of healthcare practices and research. It has provided tools to accumulate, manage, analyse, and assimilate large volumes of disparate, structured, and unstructured data produced by current healthcare systems. Big data analytics has been recently applied towards aiding the process of care delivery and disease exploration. However, the adoption rate and research development in this space is still hindered by some fundamental problems inherent within the big data paradigm. We focus on three upcoming and promising areas of medical research: image, signal, and genomics based analytics [6].

Big Data can unify all patient related data to get a 360-degree view of the patient to analyses and predict outcomes. It can improve clinical practices, new drug development and health care financing process. It offers a lot of benefits such as early disease detection, fraud detection and better healthcare quality and efficiency. The Big Data concept and characteristics, health care data and some major issues of Big Data. These issues include Big Data benefits, its applications and opportunities in medical areas and health care [7].

The Internet of Things (IoT) makes smart objects the ultimate building blocks in the development of cyber-physical smart pervasive frameworks. The IoT has a variety of application domains, including health care. The IoT revolution is redesigning modern health care with promising technological, economic, and social prospects. This paper surveys advances in IoT-based health care technologies and reviews the state-of-the-art network architectures/platforms, applications, and industrial trends in IoT-based health care solutions. IoT security and privacy features, including security requirements, threat models, and attack taxonomies from the health care perspective [8]

Big data technologies are increasingly used for biomedical and health-care informatics research. Large amounts of biological and clinical data have been generated and collected at an unprecedented speed and scale. For example, the new generation of sequencing technologies enables the processing of billions of DNA sequence data per day, and the application of electronic health records (EHRs) is documenting large amounts of patient data. The cost of acquiring and analysing biomedical data is expected to decrease dramatically with the help of technology upgrades, such as the emergence of new sequencing machines, the development of

novel hardware and software for parallel computing, and the extensive expansion of EHRs. Big data applications present new opportunities to discover new knowledge and create novel methods to improve the quality of health care. The application of big data in health care is a fast-growing field, with many new discoveries and methodologies published in the last five years. In this paper, we review and discuss big data application in four major biomedical sub disciplines: (1) bioinformatics, (2) clinical informatics, (3) imaging informatics, and (4) public health informatics. Specifically, in bioinformatics, high-throughput experiments facilitate the research of new genome-wide association studies of diseases, and with clinical informatics, the clinical field benefits from the vast amount of collected patient data for making intelligent decisions. Imaging informatics is now more rapidly integrated with cloud platforms to share medical image data and workflows, and public health informatics leverages big data techniques for predicting and monitoring infectious disease outbreaks, such as Ebola [9].

Big data analytics is a growth area with the potential to provide useful insight in healthcare. Whilst many dimensions of big data still present issues in its use and adoption, such as managing the volume, variety, velocity, veracity, and value, the accuracy, integrity, and semantic interpretation are of greater concern in clinical application. However, such challenges have not deterred the use and exploration of big data as an evidence source in healthcare. This drives the need to investigate healthcare information to control and reduce the burgeoning cost of healthcare, as well as to seek evidence to improve patient outcomes. Whilst there are a number of well-publicised examples of the use of big data in health, such as Google Flu and Health Map, there is no general classification of its uses to date. This study used a systemic review methodology to create a categorisation of big data use in healthcare. The results indicate that the natural classification is not clinical application based, rather it falls into four broad categories: administration and delivery, clinical decision support (with a sub category of clinical information), consumer behaviour, and support services. Further, the results demonstrate that the use of big data in all examples in the literature is not singular in its approach and each study covers multiple use and application areas [10].

System Analysis and Design

Proposed Architecture

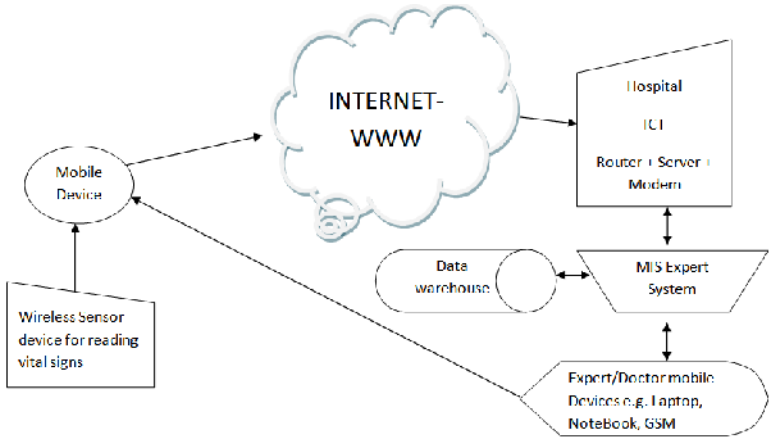

Figure 1. e-Healthcare System Architecture

This research proposes multi-agent technology to handle the patients' data management. It's a distributed solution which allows the numerous healthcare actors to share their information and benefit from sub-systems' capabilities in open distributed healthcare environments.

The proposed e-healthcare system will implement different agent categories: intelligent (problem solving agents), interaction (Interface Agent), and communication (Mobile Agent).

Types of Agents

1. Interface agent
2. Doctor agent
3. Prescription agent
4. Mobile agent
5. Lab agent
6. Diagnostic Agent
7. Mobile device agent
8. Home patient agent
9. Schedule agent
10. Electronic Health Record (HER) agent

However, each agent has its knowledge base and rules. They might assume different roles and responsibilities, and be able to communicate with other agents. Agent will be assigned to healthcare actors, specify tasks and determine the behaviours of each agent according to their roles in the e-healthcare. Agents' behaviour follows rules based on the requirements of their owners [11]. The responsibilities of each agent are outlined as follows [11]:

Interface Agent (IA):

The interface agents provide user-friendly interactive interface to assist the user in accomplishing necessary tasks, like filtering retrieved information from queries, etc. It is responsible for sending user requests to the appropriate agents, returning feedback to the user, and final presentation of results generated by other agents. This agent has the capability of learning from user's behaviour, feedback and instructions, and from other agents [11].

Doctor Agent (DA):

The doctor agent communicates with other agents to find out which is the most adequate agent to perform the requested service. The main tasks are:

1. Receive report on test results from the lab agents;
2. Receive alerts on unread test results from the alert agent;
3. Inform the doctor that test results are available;
4. Query the system according to search criteria determined by the doctor;

5. Receive diagnosis suggestions from the Diagnostic agent.

Prescription Agent (PA):

This agent is used to improve hospital pharmacy functions, speeding the time for issuing medication order, and to improve patient safety by preventing medication errors. The agent has the capability of writing prescription, transmitting it electronically to the pharmacy and checking availability of requested medication, checking for possible drug interactions or medical conditions, which may counter-indicate the use of the medication, and keep track of patient's medications. PA usage will eliminate the prescription waiting time on part of the patients or the physicians and will decrease drug's prescription errors [11].

Mobile Agent (MA):

The main function of mobile agent is to search, retrieve, and deliver data according to actor's needs. Mobile agents are generated dynamically during the execution. They can reconfigure themselves dynamically based on changes of the services. Agent consists of: set of data structures to save its parameters and information which will be sent back to user; set of functions to fulfil users' tasks, handle events and control agents' movements, and to preserve agents' status and history record; and knowledge-based model used to fulfil its mission [11].

Lab Agent (LA):

This agent should have the ability to interface with automated laboratory instruments. It's responsible for the acquisition, management and transfer of data into the patient's electronic medical record. These instruments which may come with their own software required for their operations. The agent provides real-time delivery of examination report (data and medical analysis) from laboratories that have been ordered by DA. Agent's other tasks include [11]:

1. Prioritizing the test results based on severity of patient's conditions level and informing the alert agent that test results are available.
2. Inform the DA that results are ready to be sent. If the result is requested it will make it available to the DA.

Radiology Agent (RA):

1. Receives orders and sends results of radiology tests performed by radiology machines.
2. Communicates with image archiving system.
3. Communicates with other agents such as DA, Schedule (SA), EHR, billing agents).

Diagnostic Agent (DIA):

The healthcare information systems create and store very large volumes of electronic health data related to patient services in the Case Based Database. Such huge volume of data could be used in evidence-based medicine to choose the methods of treatment and enhancing clinical

decision support of the ongoing activities. The diagnosis agent has capability to access external services and suggest proper diagnosis by using Case-Based Reasoning and associated knowledge base [11].

Mobile Device Agent (MDA):

Agent technology support mobile medical devices with a middleware enabling them to effectively use adaptive servers within their medical network environment. Agents are particularly suitable to wireless networks as they are efficient in their use of limited network bandwidth and are able to handle data transmission in frequently disconnected wireless network. An agent can represent, communicate and work towards a medical actor's interests. Healthcare organizations are increasing their reliance on mobile links to access patient information at the point of care. The usage of mobile devices will improve the quality and reduce the cost of healthcare [11].

This agent is residing on the mobile device. It is responsible for gathering and maintaining information about the physical device and its owner; and is main point of contact between the mobile user and the networked resources. Actors can use mobile applications on their PDA or mobile phone to access, retrieve and view patients' profiles and to enter patients' information such as patient monitoring data, doctor's diagnosis and prescriptions in real time. Such mobile devices can be used wirelessly at different locations around the hospital or in other situations (telemedicine) where such facilities are not offered [11].

Home Patient Agent (HPA):

This agent is added to the patient's premises software. It is used to monitor remote patient's conditions and transmit the data of abnormal cases to the mediator to handle routine healthcare activities and provide temporary advice and send urgent alerts to doctors in the event of an emergency [11].

Schedule Agent (SA):

It is used to assign the available slot of time in doctor's schedule for a patient or reschedule an appointment on the priority basis. It works in cooperation with doctor agent based on the medical consultation from patient's physician. In case of unpredicted circumstances, the agent can react flexibly to schedule a new appointment [11].

EHR agent (EHRA):

Electronic Health Record (EHR) is an integrated database holding patient's relevant digital information (textual, radiology images, ECGs, audio and waveform data, and other media content) generated during the care process. The EHR can be shared across the different healthcare setting as it is in digital format. Such information should be available to physicians, nurses and other medical staff [11].

The EHR agent provides a comprehensive set of capabilities such as [11]:

1. Real-time access to patient clinical information across healthcare systems;
2. Secure access to patient's information convenient for the healthcare staff;
3. Updating patient information in time to make fast and effective decisions.

Telemedicine agent (TA):

Telemedicine is an invaluable tool in healthcare. It provides the ability for enhancing health care delivery for patients in rural areas, reducing the travelling time for patients and health professionals, introducing training programs for medical and non-medical staff, leading to faster delivery of medical services and keeping patients satisfied [11].

Healthcare Mediator:

The healthcare mediator is the integrated unit which is made up of some healthcare transactions. To successfully complete healthcare transaction actors must interact. Healthcare mediator acts as the communication link between multiple agents of medical staff and patients. The mediator provides health services to local or remote patients [11].

Conclusion

Big data mining on patents' electronic health records will render a lot of solutions to relieve patients' from time waste, save costs and allow for prompt access to medical report and record at their convenience time. The robust system will bring about flexibility in health service sector, thereby saving much millions of lives that are impromptu to health status. Patients' big data in health service is a global emerging phenomenon that will saves life from ignorant and careless death.

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