Cloud based IoT Electronic Healthcare Data Warehouse Integration in emerging 5G Health Grid Ecosystem

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Abstract

The integration of heterogeneous enterprise cloud data warehouses enables the formation of national health grid ecosystem that links public and private health databases to enable supervision of healthcare utilities, costs, quality of care and observance of national healthcare administrative protocols. The development of cloud data warehouse requires information communication technology to condense the costs of patient's healthcare by supporting care, away from hospitals, where increasingly detailed data can move from patients to centralized cloud server data warehouse, allowing efficiency in diagnosis and treatment options. The global democratization of 5G telecommunication broadband creates entirely new use case scenarios for consumers addressing healthcare sector and industries, intending to improve citizen's life expectancy. The improved data rate transmission revolutionizes healthcare sector and offers prospects that enable the telecommunication merchants to penetrate the supply chains and initiate partnerships that profit the entire healthcare business ecosystem. This paper analyses the 5G network implementation business potentials, focusing on the 5G business opportunities that originate from industrial healthcare automation, allowing patient data aggregation required for citizens' healthcare management. The research entrenches the 5G radio frequency access network and distributed cloud IoT server systems in constructing a

healthcare grid data warehouse to enable self-optimized service-level agreements. Moreover, this paper observes that the healthcare sector prioritized telecommunication operators when partnership issues were debated above every other service sector addressing healthcare development. The cloud IoT platform offers solution to synchronize-able global device connectivity management for e-healthcare and demonstrates how these improvements enable development of new systems for public healthcare policy formulation and delivery in Nigeria.

Keywords: Healthcare Data Mining, 5G broadband transmission, cloud server system, IoT business model, e-healthcare, health informatics, health ecosystem, data warehouse, clinical database

1. Introduction

Health grid ecosystem is the system of infrastructure committed to the management of healthcare resources that incorporates various grid components and healthcare mechanisms with consistent coordination to facilitate provisions of the citizen healthcare services (Iyawa et al., 2020). The health grid encompasses various environments in which medical information are stored and made readily accessible to distinctive participants in the healthcare system supply chains such as governments, physicians, healthcare centres, patients and citizens (Umezurike, 2021). Health grids concentrate on distribution of medical information relating to privacy and ethics of health evaluation throughout the biomedical requirements amidst public health to patientcare needs. However, the individualised health grids are visualized to accelerate access to biomedical information, notwithstanding the location of the requestor of the information or the repository where the intended information are stored. Research on health grid encapsulated multiple domains of diverse operations and logistics within the electronic healthcare (e-healthcare) system development (Pramanik, Lau, Demirkan, & Azad, 2017). Those diversities are required to be handled in a systematic and well-structured arrangement in order to maintain consistency of various healthcare responsibilities.

The incorporation of cloud Internet of Things (IoT) data warehouse in the national health information systems to form a couple of healthcare data grid is crucial for ubiquitous access and sharing of citizen's medical information across platforms and agencies of government (Jain, Gupta, Nayyar, & Sharma, 2021). The evolving technologies for health grids require the integration of health information systems and various healthcare entities to form a comprehensive cloud shareable data centre. There exist characterized health grid nomenclatures which are grouped into PharmaGrid, BioGrid, CareGrid and MediGrid (Naseer,

2007). Every component of the health grids nomenclature possesses certain characteristics and functionalities. In the proposed cloud based IoT electronic healthcare data warehouse in emerging 5G health grid ecosystem in Nigeria, attention has been given to the basic relationships among various health grid configurations which will form the basis for future enterprise healthcare data warehouses development.

The development in the healthcare system through the technological advancements in the 5G telecommunication network upgrade offers great importance to the current digital society to enable healthcare industry to customize solutions required for information integration (Latif, Qadir, Farooq, & Imran, 2017). The demand for the healthcare information systems integration provides platforms for interoperability across various organizational domains for ubiquitous repositories access and sharing, through the federated biomedical and bioinformatics data warehouses as the basis for the national health grid computing (Irshad & Khan, 2021).

The e-healthcare value chain comprises of medical technology device manufacturers and vendors, network operators, software/application developers, healthcare professionals, healthcare system administrators (insurance or governments) and patients in a well-defined business communication (Panagiota, 2021). The telecommunication mobile operators actively perform significant roles in supporting mobile healthcare services and proffering solutions beyond simple device connectivity enablement. The telecommunication IoT platforms offer better access to 5G technology in the ongoing service evolution with substantial improvement in the global Internet of Everything (IoE), the computing paradigm shift that extended the IoT capabilities, emphasizing machine-to-machine communications, describing a more complex system architecture of people and processes in the business ecosystem (Kolarkar, 2020).

The 5G network technology and its commercial prospects are examined in this study with the conception surrounding the notion that 5G network public services that ushered in technologically advanced digitalization in eight key areas of global modernity would serve as a foundation for the adoption of the technology. For operators tackling healthcare transformation with reference to the introduction of 5G network technology in 2026, the forecast of USD 76 billion returns on investment translates to potential (Othman & Karagiannis, 2021). But for this transition to actually happen, cooperation, synergy, partnerships, and teamwork between different parties are absolutely essential. When discussing collaboration issues, the healthcare administrators in the cutting-edge industrial sectors frequently prioritise telecom operators over app developers and pharmaceutical firms, placing

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them at the top of the list. The healthcare industry's technology revolution offers telecom operators a wealth of chances to penetrate the investment landscape and develop ventures that benefit the whole investment and organizational environment (Sacco, 2020). In addition to their duties as network providers, telecom operators may offer system integration, app development, and homecare services, according to the healthcare and homecare industries associative nomenclature.

The creation of a high processing grid system and the aggregation of data from numerous heterogeneous sources is the scientific method behind the creation of the e-healthcare management system (Botta et al., 2016). In order to make it possible for the hospital attendants/clinicians to speed up all-inclusive healthcare responsibilities in a main stream healthcare associated occupational disposition, electronic healthcare informatics requirements need to be resolved which entails the systematic and technological acquisition, exploration, inspection, clarification, examination and administration of healthcare biodata information, absorbed through several medical transactional sources (Pramanik et al., 2017). While this is a new technology automation requirement, any service corporation built on technology motivation, profit-making drive, and customer- preoccupation had to make cloud enterprise data warehousing the top strategic business rule, as a fundamental requirement for information technology investment leverages. In this strategy, data were gathered from a variety of heterogeneous data sources, transformed, cleaned, and administered into a useful data repository for deployment throughout the healthcare executive support system for programme implementation.

In the current study, a warehouse system for enterprise cloud has been built for e-healthcare enterprise business and has linked the medical and clinical workflow via a warehouse e-healthcare data enterprise that permits the movement of medical solutions and clinical information of all the patients to be aggregated and saved in the data warehouse repository. The suggested system is anticipated to increase the control and management of patient data when the installation of 5G network technology takes effect to boast device connections by providing a model to enable medical software automation and hardware system integration. As Nigeria implement digital reforms across sectors through database integration, this proposed paper captures the health sector IT manageability automation that analyses and reports data responsibly, as they are required for data operation, schema model and health information aggregation within the healthcare business environment for national development. The introduction, literature review, research design and methodology, research

implementation, discussion of findings, future research focus, recommendation, conclusion, conflict of interest, and references make up the current paper's structure.

2. Literature Review

Enterprise cloud data warehouse integration in the 5G network technology driven infrastructures are among the topmost contemporaneous researchable areas in the computer science field, due to the current society over dependency on the computer databases, IoT, cloud computing and big data science manageability (Memon et al., 2019). The cloud computing supports the methodology for accessing the enterprise applications as utilities through the IoT independent platforms as the software are not needed to be installed on the local devices (Hashmi, Ali, & Zafar, 2021). The cloud computing is transforming the twenty first century business applications into mobile and collaborative enterprise, which enable the end user to manipulate, configure and access the hardware and software platforms remotely.

In the health sector, the accessibility of timely and accurate data is essential for citizen's healthcare governance. Healthcare organizations are confronted with several challenges with respect to voluminous medical data, clustered around numerous hospital database systems which are supposed to be aggregated to form a pull of actionable data insight (Nalinipriya et al., 2021). The enterprise cloud data warehouse designed for health grid related purposes, amalgamate data scattered throughout the healthcare organizations into a single centralized data repository (S. I. Khan & Hoque, 2015). The progressive adoption of technology -based care in conjunction with the service level management across the innovative industries creates a new approach to patient care engagement which will enable the healthcare service providers to attend to reasonable number of patient populations through leveraging the existing database information. The healthcare enterprise data warehouse is a centralized repository of medical records where patient information are integrated, processed and analysed for actionable insights required for service improvement (Gagalova et al., 2020).

According to Malik et al., (2018), the enterprise cloud data warehouse is considered a practical approach to information integration, services improvement, and models for working behind the scene making the cloud computing feasible and accessible to end users. The development of a centralized national health data warehouse for healthcare data mining operations enables communications in various hospitals, departments and diagnostic laboratories to synchronize activities relating to citizens health management. When data needed for informed medical decisions are trapped within the fragmented, heterogeneous clinical and administrative database systems, actions are required to extract, load and transform information to enable

activities that promote diagnosis and treatment optimization to improve patient care (Nugawela, 2013).

The effective healthcare data management operation requires constructing an enterprise cloud data warehouse system, to synchronize with several input devices which will permit data sharing arrangement and clinical decision-making process. When contrasted with conventional operational database system which does not satisfy the requirements for critical data analysis tasks, the enterprise cloud data warehouse promotes clinical decision-making of the users (O'Donovan et al., 2019). The enterprise cloud data warehouse system represents a comprehensive historical dataset of individuals and highly normalized for multipart enquiries and data aggregation that joined voluminous database entries from multiple heterogeneous database sources in order to produce diverse clinical descriptions as required. The healthcare data warehouse represents a data mart that is distinctive from the hospital's operational database systems (Finogeev, Parygin, & Finogeev, 2017).

According to Aceto et al., (2018), the healthcare is a field of human endeavour in which precise patient documentations are managed, and communication are delivered through the use of computing and networking technology mechanisms to efficiently and reliably circulate information relating to medical treatments and prescriptions. The National Association of Boards of Pharmacy had confirmed that there exist over 7,000 deaths from erroneous prescriptions in the United States of America yearly, which indicate that there is an urgent need to reduce those oversights in healthcare service delivery (Kart, 2010). According to Avila et al., (2017), a distributed e-healthcare system based on the service-oriented architecture can address several of these challenges as members of the healthcare ecosystem consisting of the healthcare providers (doctors, physicians, specialists, etc.), payers (health insurance companies), pharmaceutical companies, information technology and services firms and patients collaborate in a manner that promote data sharing operations. The scheme of healthcare service provision entails massive healthcare data, existing in diverse forms as structured or unstructured data sources from relational databases, file servers, and IoT sensor data accumulation (Rehman, Naz, & Razzak, 2021).

While constructing the national healthcare data warehouse grid, attention must be given to the short term business objectives to enable medium and long term goals to be realized, as healthcare organizations are meant to grow over time (Maddikunta et al., 2021). The electronic health record system were designed to stockpile medical data linking patients, services providers and agencies of the government to enable implementation of national healthcare policy (Reegu et al., 2021). The development were necessitated to enable integration of patients

and the service providers through smart and connected data grid enterprise cloud data warehouse system to grant citizens the medical data mining operations.
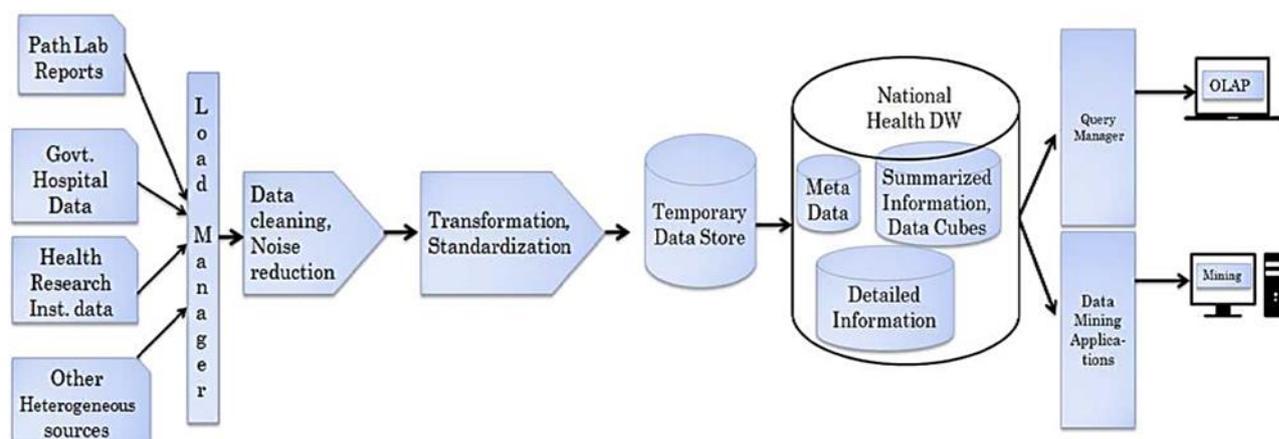

Figure 1. The Architecture of an Enterprise Healthcare Data Warehouse (S. I. Khan & Hoque,2015)

Fig.1 illustrates the architecture of national health Data Warehouse (DW) model, containing various components required for clinical data mining operations. In the above national health data warehouse design, information from different government health records and private health record sources such as hospitals, clinics, diagnostic centres, research centres were amalgamated to enable data mining and query processing through Online Analytical Processing (OLAP) which enables users to analyse information from multiple database systems concurrently (Lyu et al., 2021). The OLP is an Enterprise Data Warehouse (EDW) technology that allows database analysts to obtain and view business data from multiple perspective. The EDW analysts regularly need to aggregate and join data through Extract, Transform, Load (ETL) operation being the general techniques for copying data from one or multiple repositories into a destination system that represent data into different way in a different context than the original sources. In order to transform the extracted data into a format that complies with the target database's schema requirements, the ETL transformation procedures entailed the implementation of a number of functions and the application of sets of rules to the extracted data (Shigarov & Mikhailov, 2017). In the proposed system, the cloud enterprise data warehouse is developed to ensure that cleaning, noise reduction, and normalized data are aggregated, so that OLAP queries and data mining operations can be easily performed over the

healthcare EDW. The following are the short, medium, and long-term business needs for the EDW's objectives for the current design:

a. In order to perform projects and make business choices, it is necessary to reconcile several perspectives in line with the identical information in the extractable tables and views.

b. A comprehensive view of an enterprise database for an electronic healthcare business should be put together to help top management make decisions.

c. For future business processes that call for the practical growth of the logical data model, from the new or upgraded database, necessities that it must be accommodated inside the database centralized storehouse for information distribution and resource sharing.

d. To fulfil the criteria for data administration and integration, logical data models from all other systems should be generated or obtained, and then combined into advanced enterprise model to enable a comprehensive resource amalgamation.

e. To plan and analyse the technological frameworks for data federation, close attention should be paid to the data access methods, application layers, and data warehouse/ architecture of database.

f. The organization's electronic healthcare system's data synchronization and communication policies should be implemented using physical files, database management systems, or middleware.

g. To make point-of-entry, query, and reporting tools configurable, as well as to provide users with transparency, for creating an environment of virtual data from which any substantial advancement can emerge.

h. The national health grid policy implementation plan requires that integration of query, harmonization outcomes, and reconciliation in data to be justified for achieving the prolonged commercial goals for the healthcare organizations.

In the ongoing national health grid data warehouse design, the 5G network technology was prioritized to offer unique potential towards pre-emptive healthcare adjustment through leveraging high speed data transmission to increase the ubiquity of sensor data access, which in turn would facilitate patient access to healthcare monitoring and access to historical electronic health records (Priyanka & Thangavel, 2020). According to Campbell et al., (2017), the enormous quantities of data processed in instantaneous data mining operations required

ultra-reliable high-bandwidth networks delivery, especially when clinicians desired to access data from ubiquitous mobile devices. When switched to high-capacity 5G networks, healthcare organizations can use data mining techniques to provide the best care possible, wherever patient's records are stored, either in the public hospital or privately owned clinics (Porambage et al., 2018). In order to ensure the correctness and dependability, 5G network technology was developed to enable the enormous data file transmission instantaneously for the operation of medical data through AI based computing (Liu, Mkongwa, & Zhang, 2021). The advancement of AI and the 5G network will remove barriers to the interconnection of public and private healthcare systems and will encourage the use of advanced diagnostics and treatments in both large and small hospitals, together with some underperforming neighbourhoods as per Ahad et al., 2020. The opportunity to install and deploy AI applications linked with larger hospitals allows medical facilities in rural areas to interact and share application platforms based on 5G technology cloud IoT enablement. The 5G network technology, which has the ability to alter and improve all critical components of the healthcare system, enables the formation of a novel grid environment to address the expectations of the patients as well as the providers in the efficient manner at a sizable corporate scale.

The development of various new disruptive technologies is expected to be sped up by the 5G network technology, leading to cutting-edge use cases, major socioeconomic growth, and potential for a mobile healthcare system. Yet, network security and data privacy are crucial to build service level agreements in order to realize the full potentials of the 5G network in healthcare settings (R. Khan et al., 2019). The 5G network technology will activate total turn around in the future device communications to enable high-powered connectivity to billions of devices that will enable machines to communicate in an IoT environment. Allied Market Research report estimated that there will be about 3.7 million connected medical devices which will enable healthcare decisions to be expedited (Attaran, 2021). The adoption of mobile health operations will assist the healthcare industry to improve its services, reduce costs in the areas of counselling, rehabilitation, disease prevention and treatment (Haleem et al., 2021).

In accordance with the objectives of the national digital economy policy and strategy (NDEPS 2020-2030), Nigeria is an early adopter of the global digital economy with a focus on the timely and effective deployment of the 5G network, for a digital Nigeria. The Federal Executive Council authorized the rollout of the 5G network technology known as 5G Nigeria on September 8, 2021, to support significant infrastructure development. Following the approval of the deployment of the 5G network, the Minister of Digital Economy, Dr. Isah

Pantami, has ordered the Nigerian Communications Commission to start implementing the 5G plan right away across all digital sectors. This is being done to support the core objectives of ensuring effective spectrum assignment for the deployment of the 5G network and to facilitate the creation of an environment that will encourage investment in the telecom sector, which will drive all other sectors of the economy.
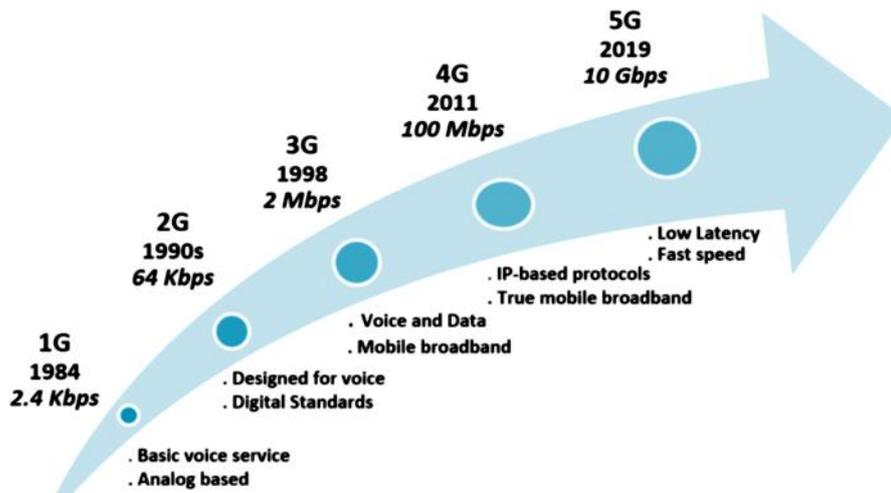

Figure 2. Effects of 5G network technology on the Development of Intelligent Automation and Industrial Digitization (Attaran, 2021).

Along with telehealth, telemedicine, remote surgery, the transfer of large medical files, tracking patient movements inside of facilities, utilizing wearable IoT sensor devices for real-time monitoring, and providing ongoing information management in validation of patientcare, the implementation of 5G network technology will promote e-healthcare (Albahri et al., 2021). According to Fig.2, the deployment of 5G network technology possesses the ability to transform e-healthcare delivery, through enhancing the data transmission speed and capacity, at the same time reducing latency which enables delivery of large medical image files, facilitating telehealth initiatives and supporting remote patient monitoring in addition to enabling more complex uses of AI and augmented virtual reality (Hermes et al., 2020). The facilitation of speedy downloads, platform communication, and mobile devices interoperability in e-healthcare settings will complement 5G Wi-Fi connectivity. While numerous health organizations embraced e-healthcare offerings, the high-quality video transmission supported by 5G network will assist patients and providers achieve speedy device connection, on the premise that 5G network covers 10 to 100 times faster than a typical 4G cellular network in the remote areas and at the site of care delivery (Matthew et al., 2021). The 5G network technology

is prepared to benefit the Internet of Medical Things (IoMT) devices and other wearable IoT sensor used to conduct remote patient monitoring to enable clinicians keep track of vital body signs, and medication adherence from a personalized care.

In the current design of cloud based IoT e-healthcare data warehouse integration in emerging 5G health grid ecosystem in Nigeria, the cloud computing technology infrastructure is configured via the internet enterprise platforms without installing those facilities on the remote systems. A distributed data warehouse based on cloud IoT infrastructure were coupled to form an enterprise data centre to enable federation of clinical information, medical records, and healthcare management information from numerous heterogeneous databases which will permit data mining on the citizen e-health records. Platforms as a Service (PaaS), Infrastructure as a Service (IaaS), and Software Resources as Service (SaaS), Applications, Servers (Physical Servers and Virtual Servers), Data Storage, Development Tools, and Networking Capabilities Hosted on a Remote Data Center and Managed by a Cloud Services Provider are all examples of the cloud computing (Alam, 2021). The objectives of cloud computing is to allow users to take advantages of disruptive technology automation, without the need of having the knowledge and expertise of the platform manageability. Cloud IoT manageability enables the healthcare organization and users to cut costs as well as to focus on their core business obligations without being bordered by IT impediments (Akhtar et al., 2021). By dividing a physical computing unit into one or more virtual ones that can be conveniently managed to carry out computing activities, cloud computing makes use of virtualization technology. Virtualization at the operating system level typically results in the creation of scalable systems made up of numerous independent computing units, allowing idle computing resources to be assigned and used in the most economical way. By maximizing infrastructure consumption, cloud virtualization will provide the agility needed to speed up IT operations and lower computing costs (A. A. Khan & Zakarya, 2021).
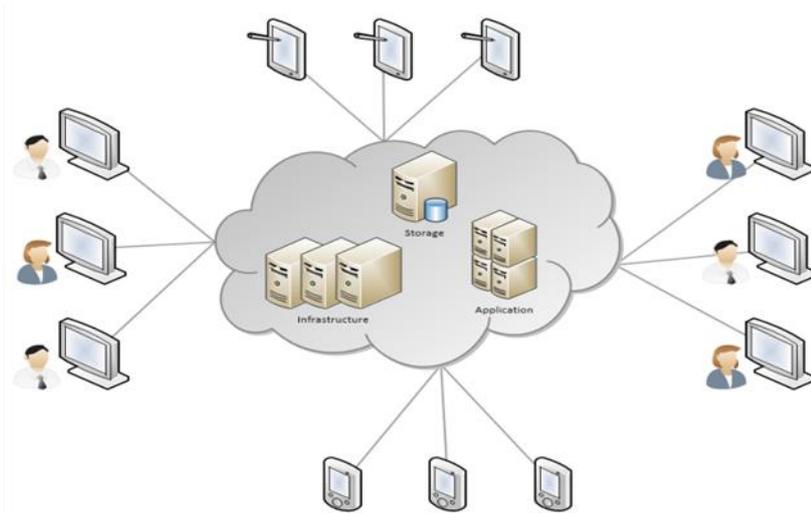
Figure 3. Cloud computing and IoT integration for smart e-healthcare (Shah, Bhat, & Khan, 2021)

In Fig.1 & Fig.3, in order to provide metrics for service improvement required for the national health grid ecosystem and to meet the demand for ubiquitous health data mining operations necessary for citizen healthcare management, the cloud computing and IoT for smart e-healthcare utilize the concepts from utility computing. Regarding the sustainability of e-healthcare, the cloud IoT computing made an effort to overcome the quality of service and dependability concerns of other grid computing models (Molo et al., 2021). Despite the fact that the worldwide market for IoT and cloud computing has expanded quickly over the years, analysts have predicted that incremental growth will continue, particularly for companies dealing with big data in e-healthcare and IoT-connected medical wearable devices (Indrakumari et al., 2020).

3.   Reasearch Design & Methodology

A cross-sectional study has been conducted using a structured questionnaire to determine how health workers felt about the integration of a cloud based IoT electronic healthcare data warehouse in Nigeria's new 5G health grid ecosystem. The need to build an EDW system for Nigerian healthcare organizations in order to coordinate the delivery of e-healthcare services with the national health grid ecosystem objective for comprehensive healthcare coverage for all citizens led to the conception of the research. Healthcare providers and logistics should be made possible passing through enterprise cloud data warehouse, the essential notion is embedded into the operational logistics of health information communication technologies and health informatics. While the EDW continue to play a role in

developing a consolidated repository of data to support the strategies and event monitoring to have a malleable choice in business intelligence, the 5G network will become a significant driver for the growth of IoT connected devices and other intelligent automations. This approach assists the maintenance of an enterprise data warehousing solution that is operationally efficient and affordable, which is essential for any business that prioritizes serving customers and involves many units and transactions. In the current study, effort are expedited to create a data federating system and integrate six hospital departments so that management could quickly and readily access all relevant data. The development of the national health grid ecosystem depends on the effective mechanization of e-healthcare solutions, which depends on the level of human capital development, the willingness of health professionals, and the knowledge of ICT experts within the healthcare provider organization and infrastructure service providers.

The approval and subsequent deployment of the 5G network technology, along with the cloud IoT data warehouse, has provided the essential enabling infrastructure that supports the sustainability of Nigeria's e-healthcare ecosystem. When it comes to software development, health informatics, pharmaceuticals, the implementation of digital health programs, and enterprise architecture enablement, the demand for local technical manpower in Nigeria far outstrips the supply, according to a survey of healthcare professionals and professional healthcare promoters. The African Capacity Building Foundation highlighted Africa's ability to organize resources, develop them, and absorb them in the right way and at the right time, during its 26th Board of Governors meeting in Accra (Ghana) in September 2017. This capability has become an important consideration for the implementation of the African Union's Developmental Agenda 2063 as well as the United Nations Sustainable Development Goals in addition to the regulations (Ufomba, 2020). However, there exist compelling body of knowledge pointing to inadequacy of capacity as key impediment to the implementation and effectiveness of various development projects and programmes in the continent of Africa. The current digital health grid ecosystem comprises of mobile health, health information technology, telehealth and telemedicine, personalized medicine and wearable device technologies utilization (Dikovic, 2021). As a result, the current research on cloud based IoT e-healthcare data warehouse integration in emerging 5G health grid ecosystem in Nigeria is designed to enable data warehouse federation through a collection of enterprise cloud information systems, such as;

i.   Consultancy Department/Customer Care Department/Emergency Department

ii.   Central Laboratory Department

    iii.   Clinical Department

    iv.   Pharmacy Department

    v.   Customers Billing Department

    vi.   Transactional Department

Any competent hospital employee with authorization has access to all information originating from one department to carry out one or more roles within the business intelligence ecosystem of the healthcare organization. Every employee can work from home thanks to the cloud enterprise data warehouse method, since all information is easily accessible from the cloud enterprise data warehouse repositories.

The following operations are abstracted from the business cloud data warehousing system using its existing design: (i.) Informing patient-related actions taken by various departments throughout the period under review that will serve as the foundation for future diagnoses or medical billing. (ii.) Utilizing biometric authentication to track each patient's unique treatment peculiarities and predicting trends in patient medical characterizations. (iii.) Module for customer billing. (iv.) As necessary, staff members make claims. (v.) Payable and receivable accounts. (vi.) Mechanism for forming policy in a structured environment. (vii.) Sales history and trends for the healthcare industry's product line. (viii.) Employee performance metrics and customer behavior are required for evaluation. (ix.) When patients move through the healthcare system, the organization should do more to increase patient safety and provide care. (x.) Gaining commercial knowledge into the efficacy of patient therapies and enhancing workflow effectiveness.

Objectively, this paper is developed to provide an overview of how a digital health innovative ecosystem can be engaged and authenticated in the Nigeria healthcare system. The methodology adopted in the development of the current paper includes conceptualisation, refinement and validation using Design Science Research (DSR) problem-solving paradigm that seeks to enhance human knowledge via the creation of innovative artefacts (Henriques & O'Neill, 2021). The major resources required for the development of the activities include knowledge of the state of the problems and the importance of its solution to be implemented. The DSR is an outcome based on information technology research paradigm that provide unambiguous guidelines for evaluation and iteration within research objectives. The DSR

concentrates on the terrific problems in enterprise database information systems which is fundamentally a problem-solving prototype for decision support schemes (MacKrell & McDonald, 2016). The problems clarified by Hevner and Chatterjee (2016) are related to the ill-defined environmental situations with attending technology and human understanding. Creativity and teamwork are required to produce effective solutions that are applicable to develop a synergetic ecosystem (Herselman et al., 2016). The methodology is substantiated in the philosophy of expediency that Nigeria, the most populous black nation of the world with above 200million citizens, require a sustainable e-healthcare system. However, this current research has also applied interpretivism within the elements of the study to evaluate and validate its findings through various workshops, scholarly articles, regional and national automated health policy, United Nations millennium development goals and World Health Organization programme on sustainable e-healthcare system.

4. Research Implementation

Fig.4 is an entity relationship illustration developed from a relational database model which is a standard tool for storing and analysing data in an organized view. These relational database models used in enterprise data design modelling include Microsoft SQL Server, PostgreSQL, MySQL, and different offerings from businesses like Oracle and IBM. A relational database program's database relationships and structures are described in a relational schema. It can be written in the Structured Query Language (SQL), which is used to create schemas or tables in a relational database object model, or it can be displayed graphically. The foundation of many servers on the cloud IoT is a relational database, which is a tool for digitally storing and analysing data. Relational databases are used to provide detailed information for everything from news websites to all known digital transactions.
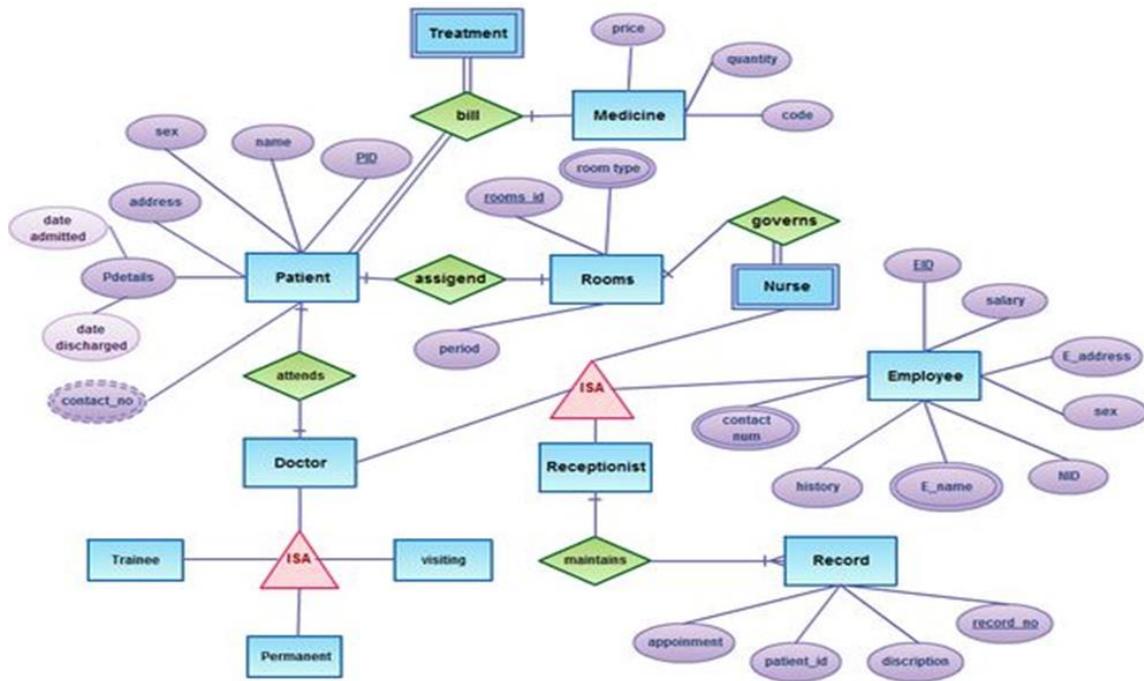
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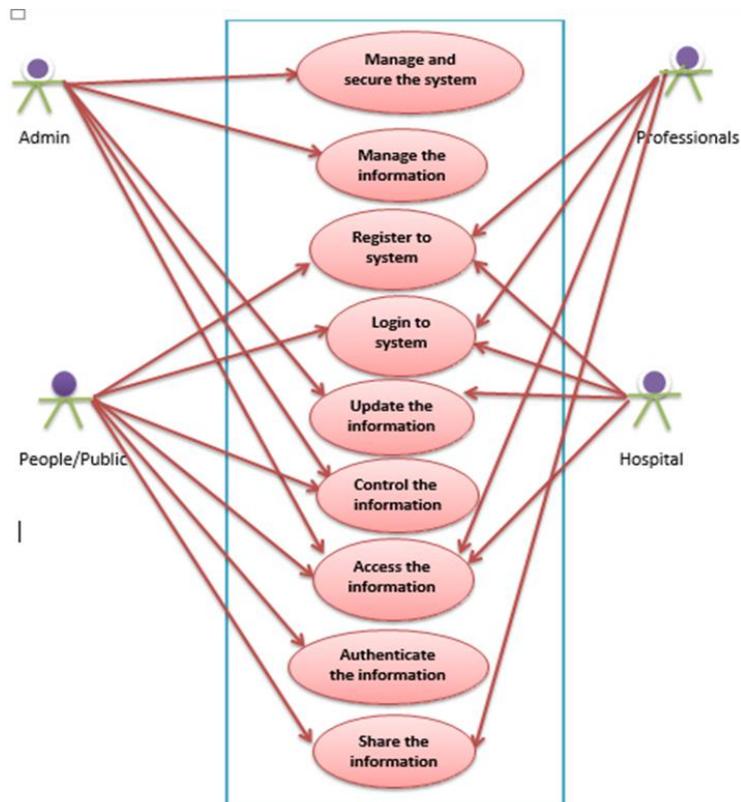**Figure 4**. The Entity Relationship Diagram of Design

Figure 5. The Use Case Diagram

In Fig.5, the Use Case Diagram (UCD) is used to illustrate various interactions between the actors (System Administrators, Hospital Workers, Healthcare Professionals and Public) in the e-healthcare ecosystem for the enterprise cloud IoT e-health data warehouse design. The UCD represents the methodology utilized in the system analysis to clarify, distinguish, and organize system requirements of the enterprise health grid ecosystem under investigation. There are unique identifications (IDs) in the proposed e-health system for the purpose of identifying sensors, people, and devices in the interactions between the system chains. In order to identify sensors in the information system channel, the system administrator generates IDs for each type of application of the e-health device. With the identification of a sensor using semantic information in an e-health supply chain, the communication entails the defining of the message-generating mechanism that is employed in the application of the e-health device.

5. Future Research Focus

Future research should focus on long term implication of EDW implementation that will require a plan to test the consistency, accuracy, and integrity of the data mart that federate into such bigger enterprise data warehouse to form a couple of cloud data centre. The EDW is expected to be well defined and time conscious to perform the duties of data reporting. In designing such EDW, attention should be given to the technical requirements, tools, life cycle, and data conflicts resolution whenever it happens. Time management should be regarded in extracting, cleaning, and loading data. The users and stakeholder's requirement including business personnel in EDW implementation process for digital health ecosystem will form the central focus to guide the operational database investment. The future e-healthcare system is the topmost global agenda and most contemporary research area that is rapidly growing with the recent implementation of digital economy across the world.

6. Recommendation

The cloud based IoT electronic healthcare data warehouse integration in emerging 5G health grid ecosystem in Nigeria using design science research methodology requires capacity building at the national level needed in providing the local support and understanding of the necessity to build, maintain, and fully utilize digital health systems. The e-healthcare paradigm shift requires training and capacity building in data use and fostering a culture to demand data and evidences needed to ensure gains realized from the new systems being developed. The approach may include partnering with the developed countries' universities to increase local

technical experts in the integration of the digital ecosystem. There exist opportunities to network, share, and learn from the experience of colleagues across the region that would serve to reinforce an emphasis on collaboration among the technical experts in deploying the new system. There should be substantial growth in digital technology solutions for healthcare through digital reforms and implementation programmes in Africa, using the following criteria:

i. Utilization of real-world case studies to examine how technological advancements like data analytics, augmented reality, remote diagnostics, and the Internet of Health Things can increase productivity and spur significant change.

ii. Regarding the digital responses to the e-healthcare system, industries require more guidance in protecting health information that increasingly flows through the national information infrastructure from patients to providers, payers, analysts, employers, government agencies, etc. and should be protected and made robust with cutting-edge technology innovation.

iii. The increased possibility of inappropriate disclosure of information held by individual organizations, whether by those with access to computerized records or by those who break into them, as well as systemic concerns resulting from open and widespread sharing of data among various parties, must be regulated by government through telecommunications/IT standards, according to the electronic record management that describe two major aspects of privacy and security concerns of publicly/privately held e-health records.

iv. Adherence to the globally recognized best practices for e-health technology and organizational information management, including fundamental security principles, effectiveness of e-healthcare technology for user authentication, access control, and encryption, barriers and incentives for the adoption of new technologies, and mechanisms for training, monitoring, and policy implementation.

v. Methods for acquiring the information necessary to confidently adopt new technologies into the workplace, motivate stakeholders, overcome common obstacles, and influence strategy both within and outside their organization.

Finally, there should be national-level leadership engagement towards creating an enabling environment to enable open communication across stakeholders for health technology solutions in Nigeria and in the continent of Africa. Therefore, the security aspects across platform integration should be taken into account while implementing a corporate cloud data warehouse. Compatibility, interconnection, and flexibility of the platforms, hardware, and software should all be carefully taken into account. Enterprise data warehousing has developed into a highly original and cutting edge corporate technology as well as the most trustworthy commercial notion for organizations to plan, forecast, and manage resources, financial activities, budget forecasts, and control logistics. Data warehouse upkeep is the primary topic that requires special attention from the research community. Poor maintenance is a major factor in data warehouse project failures, however when attention is paid to recover and maintain, the possibility of corporate warehousing of data would help business organizations to sustain competitive superiority and boost the production.

7. Conclusion

The presented paper has discussed the importance of 5G network technology in the success stories of several businesses, including the IT and healthcare sectors. The paper has appraised the role of 5G network technology in the growing industry digitization and has addressed the emerging disruptive technologies in e-healthcare automation. In the discussion of the paper, the crucial role played by 5G network technology in providing the enterprise platform communications in driving the digitization and automation of industrial practices and processes modernism have been highlighted. While 5G is not just a single technology, it is an enabler of cutting-edge technologies, consisting of IoT, big data technology, cloud computing, artificial intelligence and enterprise infrastructures. The 5G technology provide enablement that support computers to process massive amounts of information, becoming more autonomous from clinical services and building more individualized health ecosystem based on the secured communication and interactive instantaneous social network of connected IoT medical devices.

Conflict of Interest

This research is ably supported by U&J Digital Consult Limited, an IT and Educational Consulting in Nigeria. The authors wish to inform that the current research does not benefit any external sponsorship, therefore does not have conflict of interest.

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