Improve Efficiency in Management andAdministration of Immunization System through a Centralized Database System

OLANIYI O. Timothy, YUSUFF R. Shakirat, BALOGUN F. Bukola

Kwara State University, Nigeria,
Department of Computer Science, Faculty of Information and Communication Technology,
P.M.B 1530, Malete, Nigeria, E-Mail1: timolsoft@gmail.com, shakirat003@gmail.com

Abstract *– Immunization is a process by which a person is made resistant to life threatening infection diseases though vaccines' administration. Immunization history contained in the individual hand card contains vital information that is required by several users for decision making. The current manual method of keeping immunization information is prone to several challenges such as local domiciliation of immunization history, loss/damage to immunization hand cards, poor data collation process and unavailability of real-time information. The proposed centralized system will allow individual to access their immunization history anywhere and at any time. The system will ensure resident of the State can commence immunization in a health facility and continue vaccination in other facilities within the State. The system is implemented using PHP as the programming interface and MySQL as the backend. The performance of the system shows it will reduces the burden of carrying paper hand card as well as helping health care centers, government official and interested partners in speeding up report generation for decision making.*

Keywords: *immunization; centralized system; e-card; information system; vaccination.*

I. INTRODUCTION

Immunization is a process by which a person is made resistant to life threatening infection diseases through vaccines' administration. Through vaccinations people are sheltered from diseases that lead to complication and even death[4]. Immunization is a worthwhile health investment by any Government that intends to make health care accessible to all, including hard to reach and vulnerable population; and does not require any major lifestyle change. In most developing countries, immunization programs provide the only health care access for mothers and their children[3].The launch of the Global Polio Eradication Initiative in 1988, led to the near eradication of the disease; saving millions of people from paralysis[6]. Since the launch of the campaign, polio infection have been reduced by near 99% globally [2], on 21st August, 2019, Nigeria marked three -years since it reported a new case of polio and is set to be certified polio free by World Health Organisation (WHO). Vaccination is therefore one of the best discoveries for diseases preventions, eradication and life sustenance.

In Nigeria, the three tiers of government coordinated by National Primary Health Care Development Agency (NPHCDA) with supports from World Health Organization (WHO), United Nations International Children Emergency Fund (UNICEF) and other development partners are in the fore front of ensuring that all infants and eligible members of the society are immunized accordingly. The process of ensuring protection of the society from life threatening infectious diseases requires an organized and well functional Centralized System. The data from the system are needed by several users for several purposes; for instance, to ensure effective diagnosis, the clinicians will need vaccination history of the patients; the agents of the government at all levels and development partners will require the data for strategic planning and funding; immigration officers may require the immunization history of the migrant to determine eligibility for entry, some academic institutions may also require the immunization history of the newly admitted students as part of the medical records.

The Immunization process in Kwara State is done manually (Fig. 1). Every person to be vaccinated presents himself or herself (parents also present their children) at the nearest health facility that provides immunization services, either private or public owned. After the vaccination, the patient will be given a hand card. The hand card has records of all vaccines that had been taken by the patients and other mandatory vaccines not yet taken. The head of the facility on monthly basis, prepare a statistical reports of immunization done and numbers of persons vaccinated segregated by gender. The report is submitted to the Local Immunization Officer (LIO) at the Local Government Area (LGA) Level who will in turn compile for the LGA and submit to the State Immunization Officer at the State Ministry of Health.

However, this manual system of operation faces a lot of challenges; this is because the hand card easily gets lost before or after completing vaccinations, leaving no trace of information about the person's immunization history. The system makes accurate data collection and

demand for vaccination within Kwara State very difficult. It is also challenging to do periodic reports on immunization, as some of the documents are destroyed by water, fire or are unreadable as time goes by. Sometimes, patient may present at a Hospital rather than where the immunization history domiciled, the Clinician will find it difficult to diagnose the patient when decision relating to vaccination arise; this may lead to believing whatever the patient said or administer a double dose of the same vaccination.

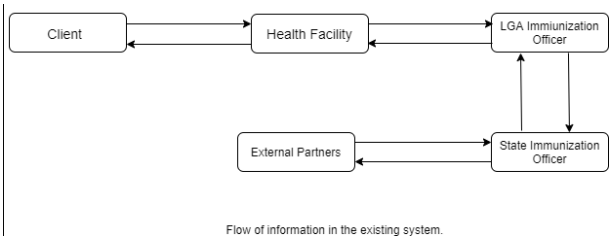


Fig. 1. Conceptual model of existing system.

The main aim of this study is to develop a web based information system that centrally maintains the immunization records of the residents of the State; ensure that data are collected and reported seamlessly and generate an e-card that is accessible and acceptable at every point of need.

The rest of the paper is organized with section 2 consists of a review of related works and a comparison of the proposed approach with other methods to deepen its difference and similarities with the other approaches at improving the immunization system in Nigeria. Section 3 describes the process involved in the design and implementation of the proposed system (Fig. 2). These include the design process using Unified Modeling Language (UML) tools and the programming tools used for the actual implementation. Section 4 discusses the results of the implementation and some of the functionality of the system. Section 5 concludes with some of the significances of the new system while section 6 gives suggestion for further line of research.

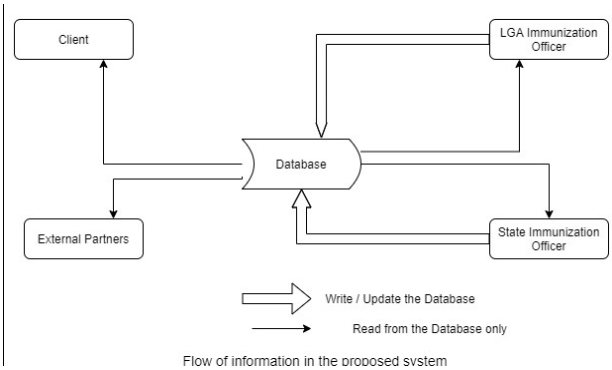


Fig. 2. Conceptual model of the proposed system.

II. RELATED WORK

There had been several research efforts at improving immunization processes in Nigeria. Some of these research focuses on improving Immunization Information System at the hospital level, improving data collection for improved surveillances and oversight reasons, some looked at improving immunization records from the users' perspective. Some of the related research works reviewed is discuss below.

[7] researched into Community Perspectives of alternative methods of keeping immunization records in rural settings of South West Nigeria. The study evaluated other methods of keeping childhood immunization recrds other than the vaccination card, based on the suggestion from the end users in the community. Questionaires, survery and focus group discussion approaches were used to obtain data from mother and care giver of under 5 children, the respondents opined that use of vaccination card is good for immunization record. However, the respondent had challenges keeping the paper card for a longer period after the completing the vaccinations. They suggested that the card be kept in the hospital or bank. Having an electronic card will ensure the card is available for use by the users at any time of need.

Also, [1] proposed a child care immunization information system that transformed the paper based recording of immunization at the University of Ilorin Teaching Hospital into an electronic method. This was achieved by developing a web based application for immunization system at the Hospital. The application was developed using HTML, PHP and MongoDB. The system improves the immunization process of the Hospital by ensuring easy access and retrieval of records. However, the application can only work within the facility it is designed for. There is no room for data consolidation from other Health Facilities with the State/Regional or National registry.

Furthermore, [5] proposed a mobile solution to enhance existing Immunization Information System by envisioning how individual can take control of their immunization information and create a platform for interaction between individual and health workers on issues such a reporting adverse event following immunization usage. A mobile solution was proposed, where individual can interact with the central Immunization Information System. The proposed mobile solution will complement the existing Immunization Information System by ensuring accurate and timely collection and transmission of immunization information. The issues of security and correctness of the data were not adequately addressed in the proposed solution. Also, pushing the responsibility of data capturing to the users may exclude some individual with no access to mobile phone or lack capacity to operate mobile apps.

[8] focused on development of an application to provide streamlined operations; enhanced administration and control and super patient care for hospital processes; these include administration, pharmacy, human resources, consultation and investigation Application was developed with JAVA programming Language and mySQL as the backend database The study indicates that the application meets the users 'expectations The

application did not give special consideration to immunization as part of hospital processes.

III. METHODOLOGY

In this research, the application is developed on three tier architecture namely: the front end, middle end and the back end architecture. The front end is implemented using HTML. CSS and JavaScript, while the Middle end is the Web Server (WAMP) that comprises of Apache, MySQL DBMS and PHP and the back end built on mySQL stores all the data that are accessible but invincible to the users of the application. The users interacts with the system via the front end where pre coded requests are triggered via click of buttons. These requests include Addition of Health Facilities, Registration of client, vaccination, view and print reports/e-card. The processing is done at the middle end by the PHP scripts; these include input validation, data verification and manipulation. The data are then sent into the back end or display to the users via web browsers. The back end provides supports for the storage, retrieval and security of data.

III.1. Use Case Model of the Proposed System.

The Use case diagram depict interractions between the system and the users of the system(actors) as show in the Fig. 3. The Client can log in to the system to view her vaccination history and print out the e-immunization card. Also, the Focal Person at the Health center, is responsible for creating a client, update client, admnister vaccine and generate vaccination reports. The State Immization is responsible for setting up Health facilities approved for vaccination of the system and generate state wide reports.

IV. RESULT

The figures below show some of the interfaces and reports for the software application developed. Fig. 4 shows the home page of the proposed system. The intended user of the system must specify his/her username, password and the category of user before allowed to the system.

This serves as security measure to prevent unauthorized person from access the system. Also, the kind of access functions permitted depends solely on the user's class. For instance a client can only be allowed to view and print his or her immunization history.

Fig. 5 is the client registration page. Any person that presented at any of the facility in the State for immunization is registered on the platform by the Hospital Focal Person, it is believed that the State will soon implement a State Wide Resident Identification for all resident of the State, however, the National Identification Number can be used to independently verify the authenticity of the information provided by client provided the person is registered on the platform. A unique username and password that identifies the client is generated for the client access to the system.

Fig. 6 is the interface for vaccination. The Hospital Focal Person uses this interface to input into the central database the antigen administered to the client per time. One of the advantage of this system is that a client can receive /vaccination in a facility other than the facility of registration.

This reduces client's defaulting as result of distance or cost associated with movement from a long destination to the Health facility. The system captures automatically the name and code of the facility that administered the vaccine and appears in the Client's vaccination history.

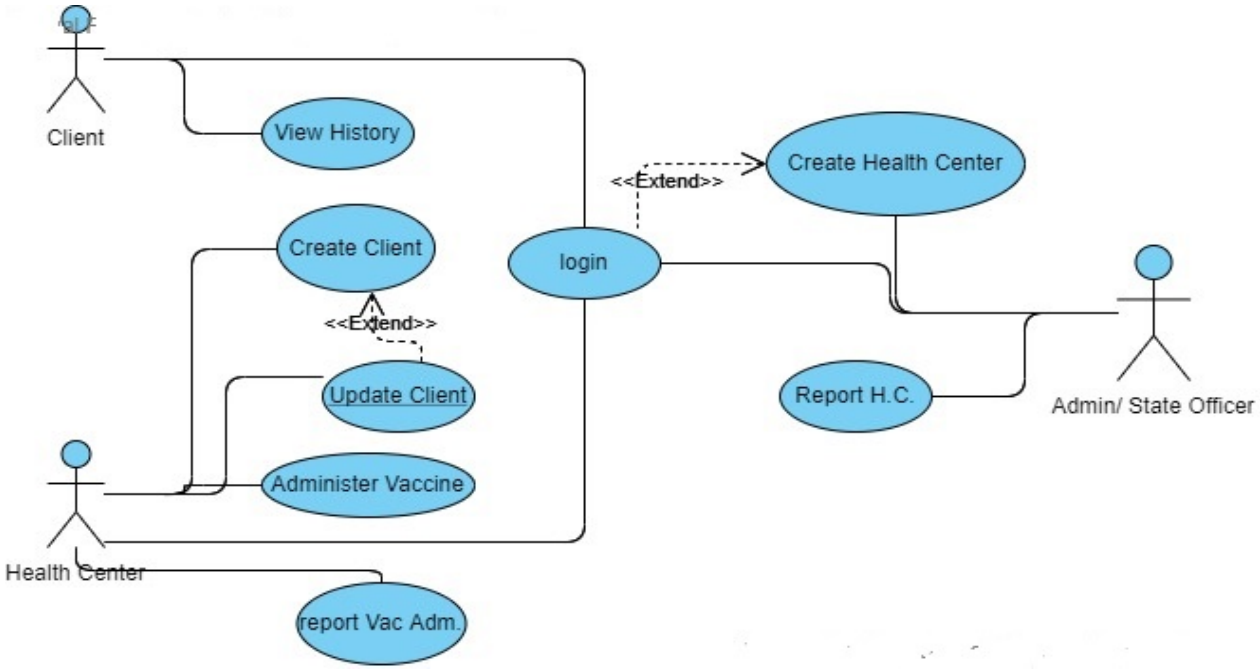


Fig. 3. Use Case diagram of the proposed system.

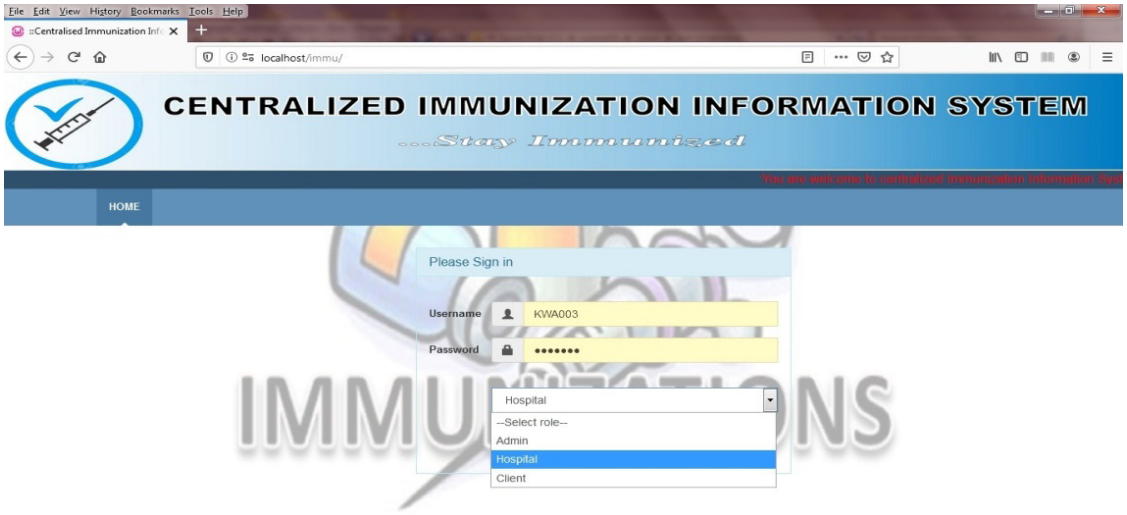


Fig. 4. The Home/Login Page.

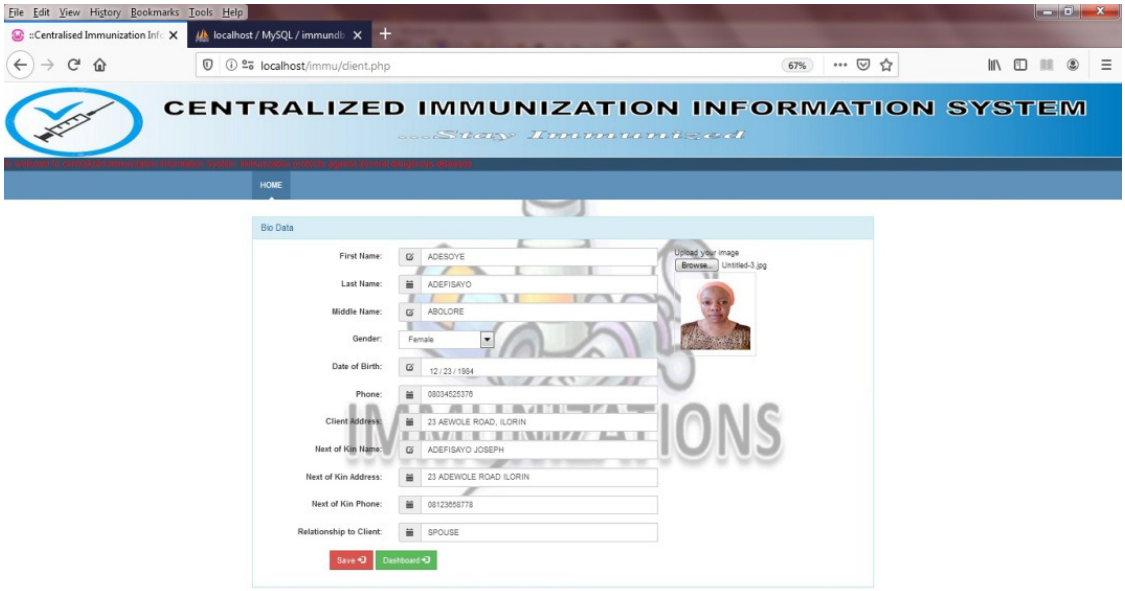


Fig. 5. Client Registration Page.

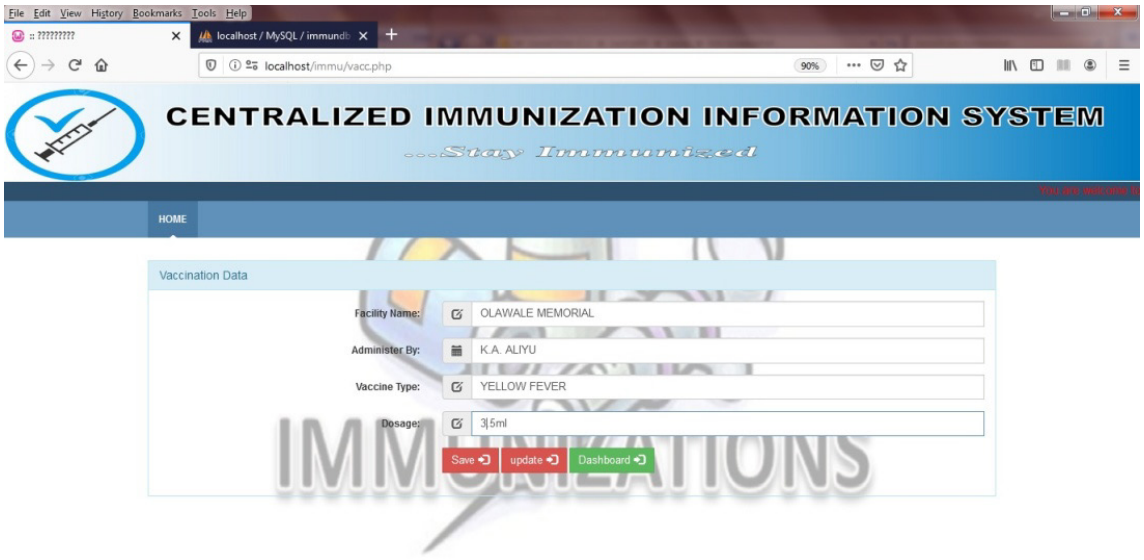


Fig. 6. Vaccination Administration Page.

V. CONCLUSION

The proposed centralized immunization system comes with many benefits. Firstly, timeliness in the recording, storing and retrieval of information both at the Health facilities and at the State Immunization office. Also, report generation is by a single click of button. The process of data collation which results in loss and inaccurate data/information is eliminated. The reports to be generated by the application will help the State and the development partners to identify population at high risk for vaccine-preventable diseases. It will enable them target interventions and the scarce resource efficiently.

Moreover, the centralized system eases the administration of immunization for residents of the State. The system link and consolidate the immunization process in the State thereby make it easy for any resident to continue receiving immunization beyond the facility, locality where they initially registered. The facilities have online access to the immunization history of the clients at any time. Furthermore, clinician can also have access to the immunization history of their patients via this platform; this will ensure an informed diagnostics decision is made as may be necessary.

The implementation of this system will ensure that persons immunized can have online access to their immunization history which can be printed and make same available to third parties as may be required. Currently, immunization history is one of the immigration requirements in most developing countries including Nigeria. Finally, it will help Schools, Day care centres make informed decision about children to be admitted to school by check out their vaccination history and ensure it is complete.

VI. SUGGESTIONS FOR FUTURE WORK

While the prospective of users of the system deemed the system as a success, there are still a number of way the system can be improved upon for better user experience and functionality. To expand the functionality of this system and make more robust, we suggest that future line of research should include addition of features such as integrating the system with National Identity Management Commission (NIMC) platform, where by the National Identity Number of citizens (NIN) will be used to validate users of the system.

This will promote government efforts to capture all citizens on the platform. Also, incorporation of machine learning and data mining techniques to the system for predicting the number of children to be immunized in the future (forecasting) based on history data generated by the system, this will enhance State government adequate preparation and strategic planning.

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