Health Records Management System Model for Public Health Centres in Uganda

Hudson Nandere* Francis Lowu
School of Computing and Informatics, Bugema University, P.o. Box 6529, Kampala, Uganda

Abstract
Uganda's public health centers have no reliable and unified source from which the medical records of patients can be obtained when needed. As a result, many medical workers gamble with medical decisions to give treatment to patients especially in case of an emergence. In spite of the fact that there exists several models/frameworks related to healthcare records, they do not show detailed individual patient care processes to capture all the required records. In addition, some models do not fit in Uganda's situation due to her limitation in technology distribution and use. Therefore, this paper presents a reliable and accurate model to curb this challenge. We conducted Semi-structured interviews at two health centers. A total of twenty five (25) respondents participated in a bid to investigate the parameters required to capture the medical records of patients. We present the context diagram, a detailed design of a model for online health records management system and use clustered column charts, pie chart and clustered bar chart to examine the themes used.
Keywords: Health Record, Record Management System, System Model, Health Center.
DOI: 10.7176/JHMN/99-04
Publication date: April 30th 2022

1. Introduction

With the vast development of technology in the world today, different systems are being implemented in healthcare organizations to improve the quality of health-care services with better data management, communication, and decision (Farzaneh, Farahnaz, & Maryam, 2014). For healthcare services and medical interventions to be given efficiently, trustworthy and integrated history of individual medical and health status are required. One of such responses is the Electronic health record (EHR) system that provides a platform on which individual health information is stored and accessed by authorized people (Kratz, 2016).

The Internet is increasingly becoming a viable source for health Information; hence scholars have acknowledged the importance of trust in the online health context (Kim, 2016). Access to the internet has dramatically improved and all countries in Africa now have direct access to the internet (Akanbi, et al., 2012). Regardless of the kind of illness, medical specialists require basic information to make medication decisions (Foster, 2012; Kratz, 2016). A Patient/Complaint's particulars such as age, place of residence, sex, among others are, required because some diseases are related to or associated with some of these for example cervical cancer affects women and not men.

More so, a complaint's history such as its onset, nature and effect on patient, any association it has on movement, drugs and any treatment taken so far, must be known as a guide to prescribe a remedy (Foster, 2012). This calls for the use of online eHealth Systems to avail patients' records even when they are in an unconscious state and unable to provide the information (Silow-Carroll, Edwards, & Rodin, 2012).

In Uganda Electronic Health Records (EHR) systems are increasingly being adopted. Just like in other developing countries, Open MRS has been implemented at nine hospitals to monitor HIV patients (Umezuruike, Nwankwo, & Kareyo, 2017). Much as various health information systems exist, they are fragmented and parallel and lack coordination (World Health Organization, 2010).

There is evidence of wide variety of systems for routine data collection and surveillance but little evidence of systems to support individual patient care (Friction & Davies, 2016). The government systems mainly focus on statistical analysis and planning hence what is collected is grouped data not individual (discrete) data (Ministry of Health, 2015). The existing related models/frameworks do not show detailed individual patient care processes to capture all the required records and some don't fit in Uganda's situation due to limitation in technology distribution and use (Ministry of Health, 2015).

2. Motivation and Problem

Uganda has an unsystematic healthcare records system and many of her citizens are not registered to any electronic health record system (Kiberu, et al., 2014; Umezuruike, Nwankwo, & Kareyo, 2017). Public health centers in Uganda have no reliable and unified source from which patients' medical records are obtained whenever needed.

A lot of time is taken to attend to individual patients at health centers in Uganda and one of the major reasons is the improper management of patients records in that, patients keep their own records in books. In case the book gets lost or has been forgotten home, a doctor/nurse has no source of patient's treatment history

resulting in spending much time and more so, he/she will lack a base for medical decisions. Consequently, many medical workers gamble with medical decisions to give patients treatment especially in case of an emergence. This improper record management is among the major causes of high death rates in Uganda's health sector (Umezuruike, Nwankwo, & Kareyo, 2017). Although several authors suggest the use of ICT to overcome the challenge, they do not provide an explicit solution. Therefore, an online health records management system model for public health centers is needed in Uganda to avail patients' health records including treatment history.

3. Objectives

The objectives of this research include a review of literature of related systems in a bid to investigate the end-user requirements, analyze the functional and non-functional requirements and then design model for online health records management system for Public Health Centers in Uganda. Lastly, to validate/examine the model by using clustered column charts, pie chart and clustered bar chart to examine the themes used.

4. Related work

If Electronic Medical Records (EMRs) are adopted by healthcare organizations, they provide many benefits to physicians, patients and healthcare services (Keshta & Odeh, 2021). An electronic health record is defined as an electronic version of a medical history of the patient as kept by the health care provider for some time period and it is inclusive of all the vital administrative clinical data that are in line to the care given to an individual by a particular provider such as demographics, progress reports, problems, medications, important signs, medical history, immunization reports, laboratory data and radiology reports (Keshta & Odeh, 2021). Today, electronic health records (EHRs) Systems, defined as "a longitudinal electronic (digital format) record of patient health information generated by patient encounters in a healthcare delivery system," (Samadbeik, 2020) are replacing paper-based patient files at most hospitals and physicians' offices (Blumenthal, 2011).

Carey et al., (2016) affirms that integrated health records systems are much effective with a lot of benefits such as low operational costs, improvement in health care quality, promotion of evidence-based medicine usage and helping in record keeping, and ensures mobility of the records. They also add that to remain effective and accurate, electronic health record system must be introduced to satisfy some requirements such as achieving complete data, resilience to failure, be highly available and be consistent to security policies (Fatokun & Sharma, 2021).

Data technology is on the verge of becoming fully portable and comprehensive and patient medical records are more accessible than ever. Electronic Medical Records (EMRs) are increasingly becoming specialized for various areas of practice and environments, allowing easy streamline of workflows, data entry improvement and increase of doctor – patient interaction (Abraham, 2017; Rathert et al., 2019).

However, the prerequisite for the full acceptance of these systems by clinical staff is that all relevant health records are available in the EHRs if they are to perform several functions and provide meaningful use (Kratz, 2015). It is becoming a requirement for physicians to document findings and look up information quickly and easily in their electronic medical record (Silow-Carroll, Edwards, & Rodin, 2012). Physicians need systems that are low in cost to use and to maintain; they need highly reliable systems which are always available, that are easy to support and protected from data loss (Stevenson & Nilsson , 2010; Atasoy et al., 2019). Systems should be easy to use, should not require long learning curves, and should promise confidentiality of patients' data (Rathert, et al., 2019).

Whereas various studies show that electronic patient records (EPR) play a major role in healthcare in modern society (Jean , et al., 2010; Atasoy et al., 2019), Marutha (2022) indicates that involvement of nurses and physicians in the design of the EPR has been negligible. The transition from manual to electronic records creates opportunities to facilitate documentation (Jean , Gunilla , Göran, & Pauline , 2010). However, this increases complexity thus it is crucial that besides having relevant and correct information in the EPR, a format that makes sense to the clinicians should be devised (Rathert, et al., 2019). So, EPRs should be well designed for documentation and user-friendly, and if not so, there is a risk that users will be reluctant to use them (Marutha, 2022; Fatokun & Sharma, 2021). On that note, the OHRMS model was designed in conjunction with end users to increase the chances of being adopted when implemented Historically, all information systems, including Health Management Information Systems (HMIS), are built upon the conceptualization of three fundamental but iterative phases: data input, data management, and data output. The data input phase includes data acquisition and data verification. The data management or processing phase includes data retrieval and data presentation (Tan, 2010; Weske, 2019).

A good number of governments have shown interest in using integrated electronic health records due to the expected benefits (Rasmi et al., 2020). The government of USA is an example in that, it made a decision in the year 2004 that most Americans were to be connected to an electronic health records system by the year 2014 (Hesse et al., 2010). Similarly, the European Union countries planned to ensure that they have a common health system by the year 2015 according to the High Level eHealth conference held in 2010. Their objective

was to perform sharing of patients electronic health records data in realizing quality and efficient health services (Benaloh et al., 2009). Nevertheless, very little has been done in developing countries to shift from the use of papers in storing health records to electronic health records systems (Marutha, 2020).

Several health information systems exist in Uganda. A report by World Health Organization (2010) shows the existance of an Integrated Diseases Surveillance and Response System (IDSR) which uses Population-based data provided through periodic surveys. Another HMIS is the Vital Registration Management Information System (VSR-MIS) which captures data at the district Population Offices (Ministry of Health, 2015). These focus on statistical analysis but cannot provided discrete patient's treatment history. The Ministry of Health (MoH) has a Health Management Information System (HMIS). This encompasses data from all levels of the health system: the village or grass roots health unit, parish, sub-county, district, and national level. Using a hybrid of paper forms, registers, and tally sheets at the health unit level, data are captured and this is primarily patient data and mortality, much as it includes health care facilities, staffing, drug supplies, family planning, and population (Uganda Ministry of Health, 2010). Although this system has been in existence for over 15years, many health centers have not yet adopted it due to its complexity and implementation needs.

5. Model Design

Before the design of the model, requirements were analyzed to specify the functional and non-functional requirements. Functional requirements included functionalities and the constraints that the model should cover, according to the demands of all affected stakeholders. Through content analysis of requirements, large volumes of data from various respondents were narrowed down to manageable volume basing on themes that appeared common and on higher demand from most of the stake holders to capture the functional requirements. The themes which emerged include: *Triage, patient's complaint, general body checkup, laboratory examination, diagnosis, and prescription. Stakeholders that were identified include: patients, nurses, doctors, lab technicians, health center administrators and system administrators.*

The context diagram (shown in Figure 1) was used to define all external producers of information used by the system, all external consumers of information created by the system, and all entities that communicate through the interface or perform maintenance and self-test. The clinician entity includes the nurse, doctor, lab technician and pharmacist. The patient has no direct interaction with the system. It is the clinician who is authorized to login in and then register the patient and add, update or retrieve all necessary patient records. The health center admin is responsible for registering the health center and updating its records.

5.1 Context Diagram

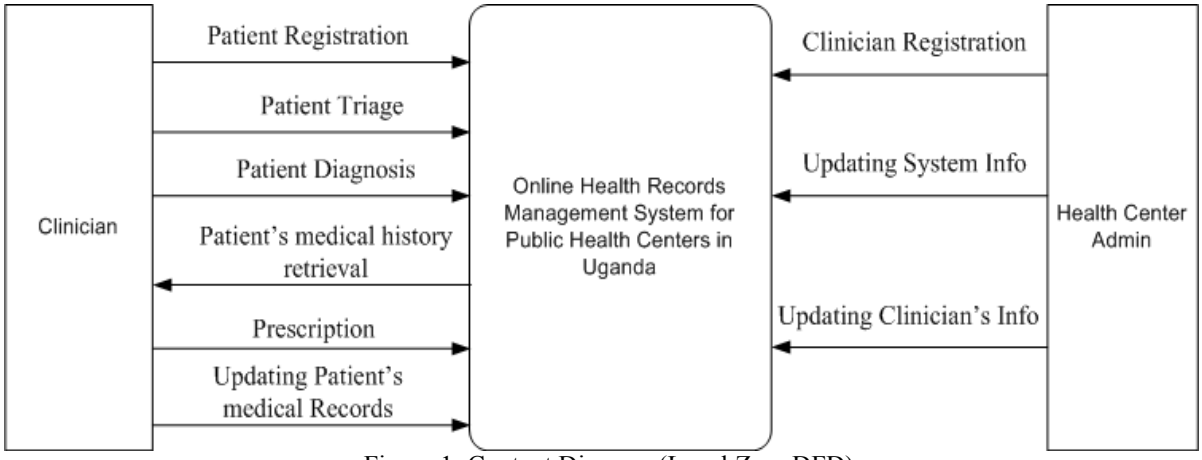

Figure 1: Context Diagram (Level Zero DFD)

5.2 The Online Health Records Management System (OHRMS) Model

A model for online health records management system for public health center in Uganda was designed. The themes that emerged and the design elements from the analysis of results were included in the model. In this model (Figure 2), processes are represented as rectangles while those with pre-defined steps are represented by rectangles with double lines on the two parallel sides. A process may require access of information from the system to be accomplished and this is represented by an arrow from the system (circular shape). A process may also lead to insertion of data into the system, represented by an arrow to the system. These processes are associated with various actors or entities that's to say; nurse, doctor, lab technician, pharmacist, system admin and health center admin. These are shown by the rounded corner rectangles. At times, decisions must be made

for another process to follow. This is represented by a rhombus shape with YES and NO directions. Processes may also occur concurrently which is shown by two parallel lines with space in between.

This model presents the processes that a patient goes through for their medical records to be added to the system and there after retrieved when required by authorized user s to accomplish other processes. When a patient arrives at the health center, the nurse registers them in the system by capturing their triage data and strictly using a National ID as the unique patient's identifier, after which they present their complaint and its history. The nurse may need retrieval of patients past medical history at this time in case of an old patient. General medical checkup follows and then a lab test by a lab technician if needed. The doctor then performs diagnosis and prescribes or refer the patient in case the illness can't be handled hence departing from the health center. Basing on the patient's condition, they can be admitted or just be given medicine/drugs by the Pharmacist and/or injection after which they depart. All the information regarding these processes is saved in the system by the respective user. If the patient is admitted and doesn't recover, they are referred and hence they depart.

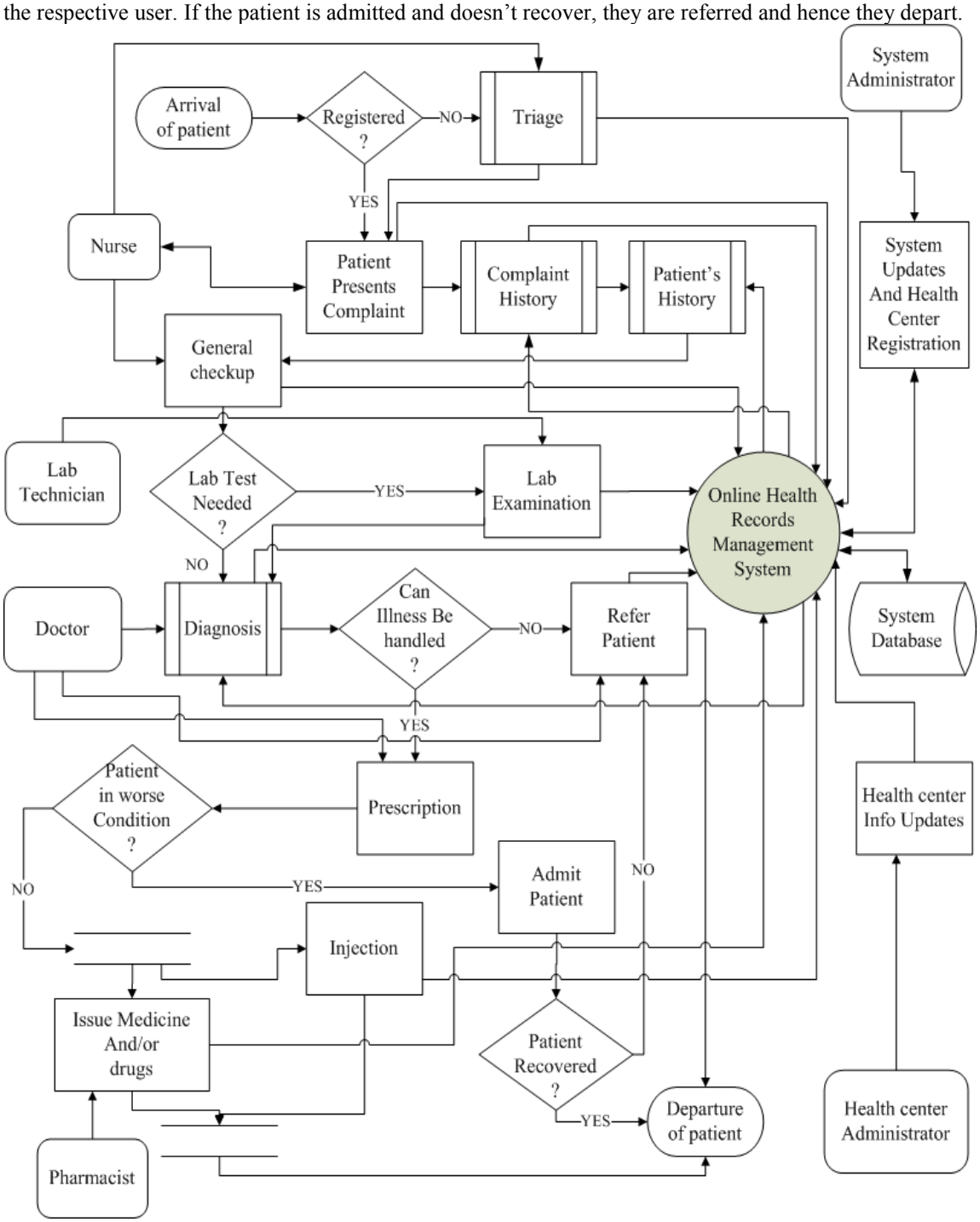

Figure 2: The Online Health Records Management System Model

6. Discussion and Contribution

In this paper, the researchers present a model;

- That presents detailed individual patient care processes to capture all the patients' records required by health workers especially in case of an emergency.
- That fits in Uganda's situation due to limitation in distributed network technology. As the use of internet is dramatically increasing in Uganda, this model can be implemented to utilize the trend in Uganda's technology as it suggests online access and usage.
- That suggests storage and access of patients' data from various health centers from the same source hence enabling sharing or patients' medical history by authorized health workers whenever needed.

The model was developed after review of literature and interviewing respondents from the two health centers. First, a review of literature of related systems was carried out in twenty one (35) research papers. This helped to identify the three (3) primary user requirements for the patients' medical data. These include; *Data Input, Data Management* and *Data Output as shown in Figure 3*.

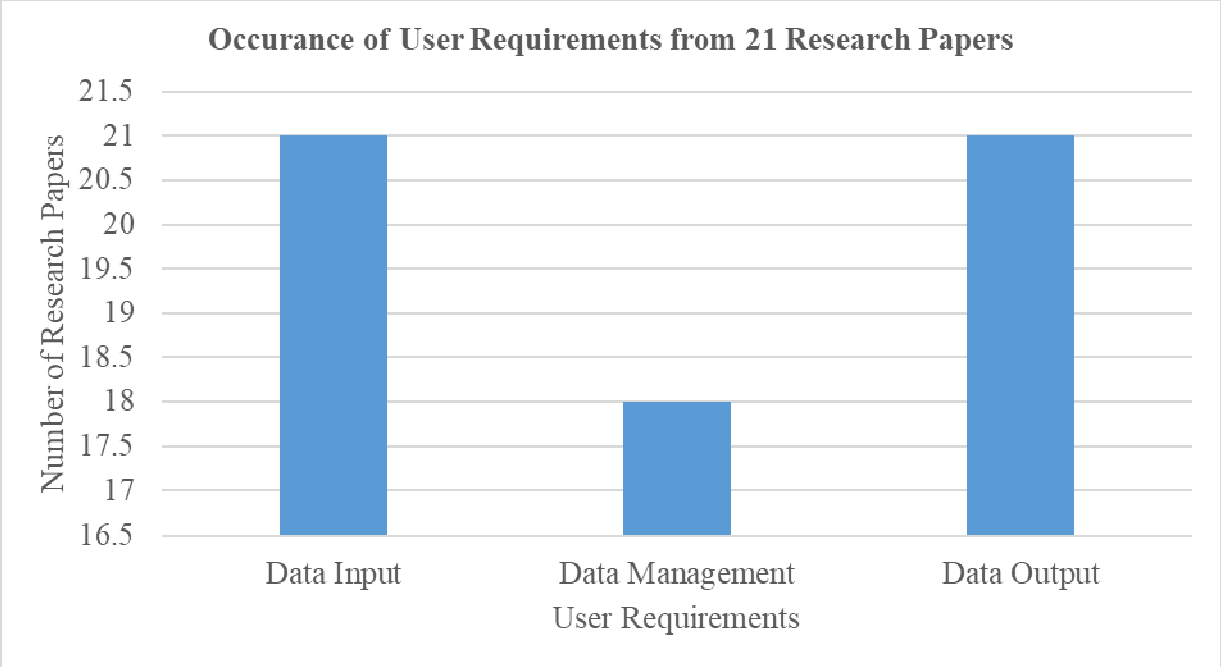

Figure3: A Clustered Column Chart Showing the Occurrence of User Requirements

Secondly, requirements were gathered and after analysis, themes emerged that were considered in capturing functional requirements (shown in Figure 4). Actors in the system were identified, their functions and constraints imposed on their services (non-functional requirements).

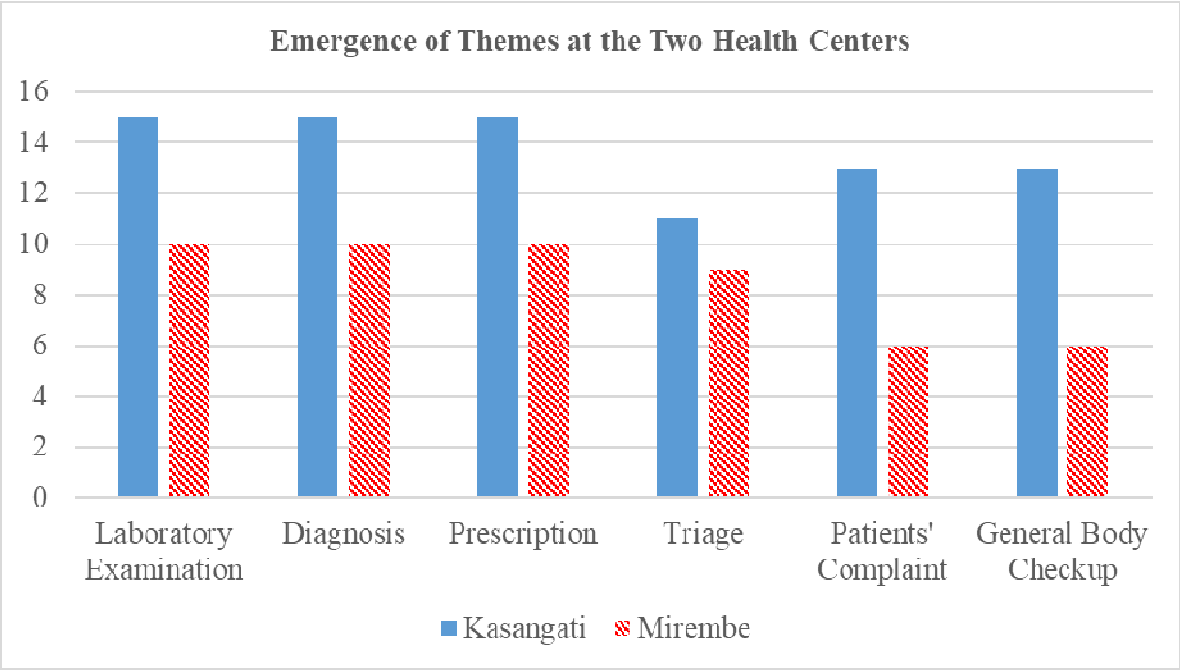

Figure 4: Clustered Column Chart comparing emergence of themes

More so, a model was designed encompassing all essential elements such as required objects (user interfaces) and processes specified as shown in Figure 5. Respondents expressed the need to share information among health workers in different health centers (shown in Figure 6). Therefore, the model was designed to provide access of information in a unified source (database).

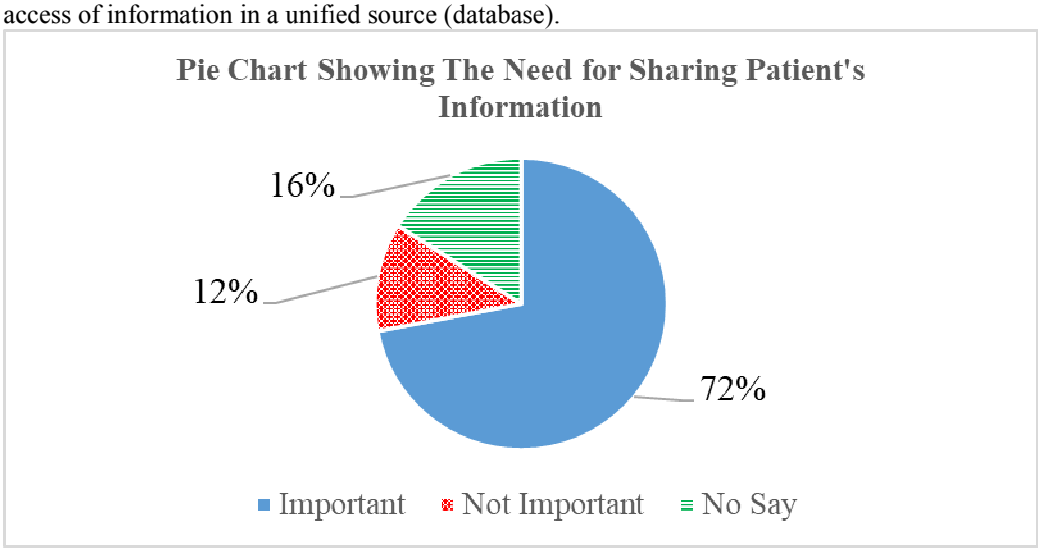

Figure 5: The Need for Sharing Patients' Information

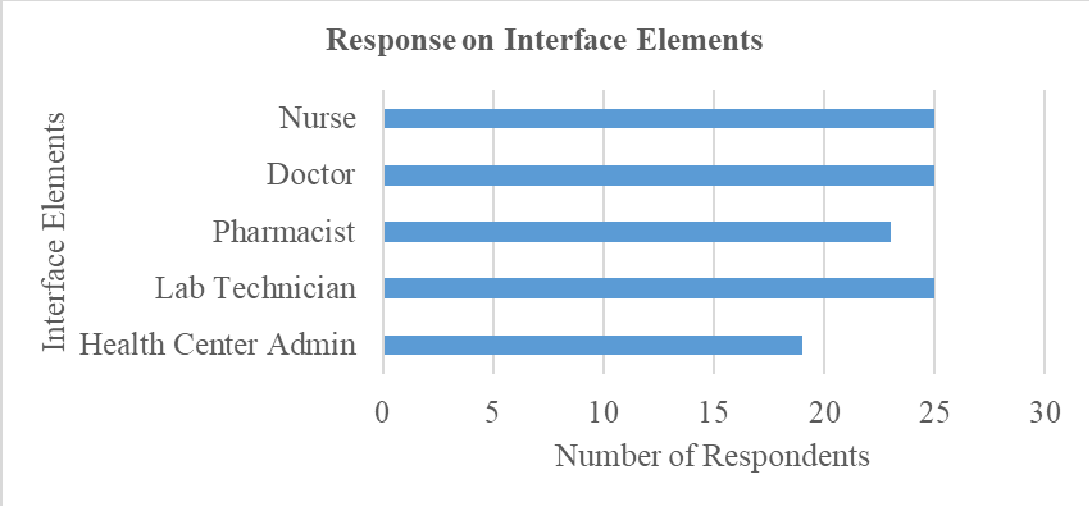

Figure 6: Clustered Bar Chart Showing the Response on Interface Elements

7. Recommendation and Future Work

In the modern world, the use of computers, internet and web based applications is becoming rampant (Akanbi, et al., 2012). More so, recent developments in the ICT Industries has revolutionized and consequently brought about a paradigm shift in the way activities are accomplished (Hossain et al., 2019). As a result the, Health sector needs to embrace these new technologies. This paper has presented a simple, convenient, cost-effective, but efficient, reliable and accurate Online Health Records Management System Model with efficient processes. Further research is recommended in order to widen the scope of this model so that it can include the following:

- Integrating existing health management systems to work with the model.
- Cover all hospitals/medical centers/health centers both private and public.
- Capture, search and display patients' records using biometric technologies such as eye scan and finger prints.

8. Conclusion

The aim of this research was to design a model for online health records management system for Public Health Centers in Uganda. The model has been presented in this study (as shown in Figure 2). This purposes to provide a systematic flow or patients' healthcare processes to capture and avail health records to clinicians to make correct medical decisions. By implementing the model, death rates are sure to reduce in developing countries including Uganda. In this research, we made a thorough document review of existing literature and identified the three (3) primary user requirements for the patients' medical data. These requirements are data input, data management and data output as shown by the graph in figure 3. In addition, we have provided the brief analysis of the results from the correspondents at two health centers in which prominent themes emerged and were considered in capturing functional requirements (shown in Figure 4). More so, we provide the common interface elements that result from analyzing the correspondents' interviews (shown in Figure 6). According to the study, any health records system should at least have these interface elements; nurse, doctor, pharmacist, lab technician, and health center administrator, for the actors to interact with the system.

9. Acknowledgement

This work was supported by the directorate of research and School of Computing & Informatics, Bugema University.

10. References

Abraham, B., 2017. Comparative study of healthcare messaging standards for interoperability in ehealth systems (Doctoral dissertation, Western Sydney University (Australia)).

Abraham, B., 2017. Comparative study of healthcare messaging standards for interoperability in ehealth systems (Doctoral dissertation, Western Sydney University (Australia)).

Akanbi, M.O., Ocheke, A.N., Agaba, P.A., Daniyam, C.A., Agaba, E.I., Okeke, E.N. and Ukoli, C.O., 2012. Use of Electronic Health Records in sub-Saharan Africa: Progress and challenges. Journal of Medicine in the Tropics, 14(1), pp.1-6.

Atasoy, H., Greenwood, B.N. and McCullough, J.S., 2019. The digitization of patient care: a review of the effects of electronic health records on health care quality and utilization. Annual review of public health, 40,

pp.487-500.
Benaloh, J., Chase, M., Horvitz, E. and Lauter, K., 2009, November. Patient controlled encryption: ensuring privacy of electronic medical records. In Proceedings of the 2009 ACM workshop on Cloud computing security (pp. 103-114).
Blumenthal, D., 2011. Implementation of the federal health information technology initiative. New England Journal of Medicine, 365(25), pp.2426-2431.
Carey, D.J., Fetterolf, S.N., Davis, F.D., Faucett, W.A., Kirchner, H.L., Mirshahi, U., Murray, M.F., Smelser, D.T., Gerhard, G.S. and Ledbetter, D.H., 2016. The Geisinger MyCode community health initiative: an electronic health record–linked biobank for precision medicine research. Genetics in medicine, 18(9), pp.906-913.
Farzaneh , A., Farahnaz , S., & Maryam , A. 2014. Utilization of open source electronic health record around the world: A systematic review. Journal of Research in Medical Sciences, 57-64.
Fatokun, T., Nag, A. and Sharma, S., 2021. Towards a blockchain assisted patient owned system for electronic health records. Electronics, 10(5), p.580.
Foster, R., 2012. Review of developing country health information systems. A High Level Review to Identify Health Enterprise Architecture Assets in Ten African Countries: Jembi Health Systems.
Fricton, J.R. and Davies, D., Personal Health Records to Improve Health Information Exchange and Patient Safety.
Hesse, B.W., Hansen, D., Finholt, T., Munson, S., Kellogg, W. and Thomas, J.C., 2010. Social participation in health 2.0. Computer, 43(11), pp.45-52.
Hossain, N., Yokota, F., Sultana, N. and Ahmed, A., 2019. Factors influencing rural end-users' acceptance of e-health in developing countries: a study on portable health clinic in bangladesh. Telemedicine and e-Health, 25(3), pp.221-229.
Keshta, I. and Odeh, A., 2021. Security and privacy of electronic health records: Concerns and challenges. Egyptian Informatics Journal, 22(2), pp.177-183.
Kiberu, V.M., Matovu, J.K., Makumbi, F., Kyozira, C., Mukooyo, E. and Wanyenze, R.K., 2014. Strengthening district-based health reporting through the district health management information software system: the Ugandan experience. BMC medical informatics and decision making, 14(1), pp.1-9.
Kim, Y., 2016. Trust in health information websites: A systematic literature review on the antecedents of trust. Health informatics journal, 22(2), pp.355-369.
Kratz, A., 2016. Electronic reporting of all reference laboratory results: An important step toward a truly all-encompassing, integrated health record. Health informatics journal, 22(3), pp.496-504.
Marutha, N.S., 2020. Landscaping health-care system using functional records management activities. Collection and Curation.
Marutha, N.S., 2022. Studying medical records management in the public healthcare sector of South Africa using multi-method. In Research Anthology on Innovative Research Methodologies and Utilization Across Multiple Disciplines (pp. 114-134). IGI Global.
Ministry of Health, 2015. Health Sector Development Plan 2015/16–2019/20.
Rasmi, M., Alazzam, M.B., Alsmadi, M.K., Almarashdeh, I.A., Alkhasawneh, R.A. and Alsmadi, S., 2020. Healthcare professionals' acceptance Electronic Health Records system: Critical literature review (Jordan case study). International Journal of Healthcare Management, 13(sup1), pp.48-60.
Rathert, C., Porter, T.H., Mittler, J.N. and Fleig-Palmer, M., 2019. Seven years after Meaningful Use: Physicians' and nurses' experiences with electronic health records. Health care management review, 44(1), pp.30-40.
Samadbeik, M., Fatehi, F., Braunstein, M., Barry, B., Saremian, M., Kalhor, F. and Edirippulige, S., 2020. Education and Training on Electronic Medical Records (EMRs) for health care professionals and students: A Scoping Review. International Journal of Medical Informatics, p.104238.
Silow-Carroll, S., Edwards, J.N. and Rodin, D., 2012. Using electronic health records to improve quality and efficiency: the experiences of leading hospitals. Issue Brief (Commonw Fund), 17(1), p.40.
Tan, J. ed., 2010. Developments in Healthcare Information Systems and Technologies: Models and Methods: Models and Methods. IGI Global.
Uganda Ministry of Health. (2010). Standard Operating Procedures for Health Information. Retrieved from http://www.health.go.ug/hmis/public/files/sop.pdf
Umezuruike, C., Nwankwo, W. and Kareyo, M., 2017. Implementation Challenges Of Health Management Information Systems In Uganda: A Review. development, 4(7).
Weske, M., 2019. Business Process Management: Concepts, Languages, Architectures. Springer.
World Health Organization and University of Queensland. School of Population Health, 2010. Improving the quality and use of birth, death and cause-of-death information: guidance for a standards-based review of country practices.