Proceedings of the 9th Health Informatics in Africa Conference

HELINA'14

PART I

Informatics for Universal Health Coverage in Africa: From Point of Care Systems to National Strategies

Editors: Nicky Mostert-Phipps, Frank Verbeke, Mikko Korpela, Ghislain Kouematchoua, Ulrich Kemloh

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Editorial to the HELINA 2014 proceedings

The HELINA 2014 conference

The 9th HELINA (**HE**a**L**th **IN**formatics in **A**frica) conference was organized from 7 to 11 March 2015 in Accra, Ghana. HELINA is the pan-African health informatics organization which has a tradition of organizing this event that goes back to 1993. The conference is focusing on health informatics needs, development, education and strategy on the African continent. Previous editions have been hosted in Nigeria (1993), South Africa (1996 & 2003), Zimbabwe (1999), Mali (2007), Ivory Coast (2009), Cameroon (2011) and Kenya (2013). The 2014 edition was originally scheduled for October 2014, but due to a Ghanaian government ban on international gatherings in the light of the West African Ebola crisis, the conference had to be postponed to March 2015. The event has been organized by the Ghana Health Informatics Association (GHIA) which provides a national scientific platform for health informatics activities in Ghana and is a registered member of the International Medical Informatics Association (IMIA) and HELINA. GHIA's members are professionals, researchers, companies and organizations involved in (public) health, health informatics, health insurance and computer science in Ghana.

Conference themes

The call for submissions for HELINA 2014 covered a broad range of health informatics topics with relevance for Africa under the title "**Informatics for Universal Health Coverage in Africa: From Point of Care Systems to National Strategies". Academic research papers, work-in-progress papers and practical presentations where solicited within the following themes:**

- Highlighting the role of Health Informatics applications for the Universal Health Coverage in Africa
- Promoting the development and implementation of an African e-Health strategy as well as the development of e-Health strategies, policies, and architectures in each African country
- Showcasing best practices in Health Informatics –incl. e-Health and telemedicine- and its application in Africa: implemented health data standards and interoperable solutions, hospital information system, electronic health/medical/patient records, clinical decision support systems, monitoring and evaluation systems, registers, data mining, big data analytics and reporting platforms, health insurance and electronic claims processing among others
- Translating research and innovations into improved healthcare delivery system
- Fostering the creation of networks between African Countries as well as e-Health initiatives in Africa
- Fostering the development of Health Informatics research and education in Africa.

Submissions of papers that fell outside any of these themes were also acceptable as long as they demonstrated any relevance for the health informatics domain in Africa.

Review process

The conference being initially planned from 11 to 15 October 2014, a first call for papers was published in English and in French on 11 April 2014 with a deadline for submissions on 16 June 2014. After postponing the conference to 7-11 March 2015, the deadline for submissions was also extended to 16 November 2014.
The General Conference Chair appointed the Scientific Programme Committee (SPC) chair and co-chairs who started in April 2014 to invite international experts (n=20) with prior experience in Health Informatics in Africa to become members of the SPC. The same SPC remained also in place after the paper submission deadline extension.
A total of 59 submissions have been received in due time for the HELINA 2014 conference. A double blind peer review process was used for evaluating each paper in a first round. All received submissions were anonymized before being submitted to at least 2 reviewers according to their expertise. The reviewers had the option to accept submissions either as full research papers, work-in-progress papers

or practical presentations. The SPC chairs based their final decision on the acceptance of each submission on the recommendations and comments from reviewers. Accepted full research papers and abstracts were then sent back to the authors for revision according to the reviewers' comments. The final reviewed paper versions submitted by the authors were checked by the SPC chairs on technical criteria. This review process resulted in the following acceptance rates:

- Full research papers: 17% (n=10)
- Work-in-progress and practical presentation papers: 61% (n=36)
- Rejected or retracted papers: 22% (n=13)

In order to be included in the conference proceedings, an accepted paper had to be presented in the conference.

HELINA 2014 conference content

Conference papers have been organized in a number of thematic tracks. The most popular topics were *National e-Health strategies, policies and architectures* (7 papers), *Health information systems analysis, development, implementation and assessment* (6 papers) and *Health informatics education, research methods and capacity development* (4 papers). Other tracks included:

- Point of care health information systems
- Data mining, big data analytics and national health data reporting platforms
- Integrated healthcare and universal health coverage
- Informatics in the implementation of monitoring and evaluation systems
- Health information systems an integration of vertical health programmes and specialized care
- Empowering communities and community participation
- Software architectures interoperability, health data standards and controlled vocabularies

For practical reasons, 3 papers written in French related to e-health strategies and universal health coverage were organized in a separate track.
The HELINA 2014 conference brought together on 9 and 10 March 2015 contributions from 14 developing countries: Burundi, DR Congo, Ethiopia, Ghana, Haiti, India, Ivory Coast, Kenya, Malawi, Nigeria, Rwanda, South-Africa, South-Soudan and Tanzania. Other contributors came from Belgium, Canada, Finland, Germany, Norway, The Netherlands and the United States. The papers presented showed that standardization and (semantic) interoperability as well as health informatics education and capacity development have become the dominant themes for the health informatics domain in Africa. These two themes clearly received more attention in HELINA 2014 compared to other global or regional conferences such as MEDINFO and MIE. This was picked up by the HELINA organization through the creation and strengthening of working groups on education and interoperability. It was also decided to create a separate taskforce within the working group on education for the development of health informatics curricula in French.
Preconference tutorials, meetings and workshops have been organized on 7 and 8 March 2015 and received a lot of attention:

- Tutorial on big data analytics and data mining followed by a meeting of the HELINA working group and big data analytics
- Tutorial on health information systems and interoperability with practical examples based on the OpenClinic GA open source health facility information system
- Tutorial on SNOMED CT as an example of a framework for HIS semantic interoperability
- A HELINA and INDEHELA event on the development of health informatics education and training with the creation of the HELINA working group on education
- The HELINA general assembly with the election of a new board for the next 2 years

On 11 March a post-conference session was finally organized on National e-Health Strategies in Africa and the development of a HELINA strategy.
The HELINA 2014 conference demonstrated that health informatics activities and implementations gradually come to maturity in Africa. Many initiatives are underway in different fields ranging from point of care user centric solutions to national monitoring and evaluation systems based on aggregate data. Universal health coverage plans are giving a new boost to developments in this area. Important

challenges remain in the sphere of user acceptance and data quality improvement. Massive investments in health informatics training and education, implementation of a better return on investment for health workers and regional (semantic) standardization will be necessary in order to cope with these issues in Africa. Progress is being made every year and therefore Africa is on the right track to achieve better healthcare through better information management for its citizens.

Nicky Mostert-Phipps
HELINA 2014 SPC Chair

Frank Verbeke
HELINA 2014 SPC co-Chair

FULL PAPERS

Following full papers are published in a special issue edition of the Journal of Health Informatics in Africa (JHIA) dedicated to the HELINA'14 conference.

- The Ethiopian national eHealth strategy and its alignment with the health informatics curriculum
  Binyam Tilahun, Atinkut Zeleke, Mengistu Kifle, and Fleur Fritz

- The European initiative EHR4CR – Lessons learned for EHR implementations in Africa
  Fleur Fritz, Binyam Tilahun, and Martin Dugas

- Developing a national e-health strategy for DR Congo: a preliminary analysis of business needs, existing information systems and solutions
  Frank Verbeke, Pierrot Shamashanga, Clément Amisi, and Gustave Karara

- Peer-performance review as a strategy for strengthening health information systems: a case study from Ghana
  Adaletey Denis Leonard, Jolliffe Bob, Braa Jørn, and Ofosu Anthony

- When information technology meets healthcare in West Africa: a literature review
  Welborn Amoako Marful and Alfred Winter

- eHealth strategy development: a case study in Tanzania
  Niamh Darcy, Mturi Elias, Andrew Swai, Happy Danford, Hermes Rulagirwa, and Sriyanjit Perera

- Mobile-health tool use and community health worker performance in the Kenyan context: a quasi-experimental post-test perspective
  Maradona Gatara and Jason F Cohen

- Good practices to enhance the perceived usefulness of computerized hospital information systems – case study in Nigeria
  Vilma Vainikainen, H. Abimbola Soriyan, Mikko Korpela, and Kaija Saranto

- The maternal healthcare landscape around Grabouw, South Africa: setting the stage for information systems development
  Siphokazi Tswane, Mikko Korpela, Doreen KM M'Rithaa, and Boniface Kabaso

- Building locally relevant models for universal health coverage and its implications for health information systems: some reflections from India
  Sundeep Sahay, T. Sundararaman, and Arunima Mukherjee

SHORT PAPERS
and
WORK IN PROGRESS

Implementation of an enhanced inter process communication for health information systems

Soriyan, H.A.[a], Ajayi, A.O.[a], Famutimi, R.F.[b], Ikono R.N.[a]

[a]Computer Science and Info. Technology Dept. Bowen University Iwo, Osun State
[b]Computer Science and Engineering Dept.Obafemi Awolowo University, Ile Ife

The development in technology which resulted in continuous availability of ever increasing processor speeds has contributed greatly to the success of distributed network systems employed in many domains. This paper explored the advantages of distributed network systems in the implementation of an enhanced inter-process communication for health information systems. In Health information systems, timely retrieval of relevant information is very important for life saving systems. This paper implemented an enhanced inter-process communication to improve the performance of information management systems that are based on traditional (normal) remote procedure call for accessing health information systems' database file servers. The performance parameters used are the response time and the throughput. The implementation was carried out such that tasks are not implemented immediately, but are first examined to determine the weight of the tasks (query) and then allocate rank to the query. The rank obtained was used to determine the node that will implement the query. Both traditional and the enhanced inter-process communications were implemented and the result showed that there was a better performance in the implementation of the enhanced inter-process communication model when using response time and throughput as parameters.

Keywords: task weight, ranking, inter-process, communication, query task, remote procedure call.

1   Introduction

The combination of computing and networking technologies gave birth to the new paradigm of computing called parallel and distributed computing in the late 1970s. Sabu, M. (2009). Parallel computing is embedded in distributed computing. The computing method has now changed, because there is demand for fast response to database enquires.

A parallel and distributed computing system is the architecture that makes it possible for a collection of computer workstations (nodes) either heterogeneous or homogeneous to behave as a single computing system. In this type of computing, users can utilize resources from any of the workstations, execute processes or programs anywhere in the system. Hariri, S. & Parashar, M. (2004). The continuous demand for increased computing power and different requirements has brought about a situation whereby a single computing platform will find it increasingly difficult to meet these demands. As a result of this, computing environments now make effective use of the existing heterogeneous or homogeneous computing resources that are available in a network of systems. This integration is only possible with the use of parallel and distributed system technology; hence its emergence. A distributed system is a computing system in which a number of components cooperate by communicating over a network. It is a collection of autonomous computers linked by a computer network that appear to the users of the system as a single computer (Petru, 2010).

Many researchers, Vincent, O.R. et al.(2010); Mangalwede, S.R. & Rao, D.H. (2009); Yousry, E., Khalid, E. & Magdy, S. (2007); Aderounmu, G., Adekiigbe, A. & Iyilade, J. (2004); Kunal, S. (2003); Robert, S.G. et al. (2001); Ismail, L., Hagimont, D. & Mossiere, J. (1999) have proved that there is a challenge in the use of traditional remote procedure call. Notable among the challenges of traditional remote procedure call in a distributed system is Load Imbalance on client's nodes while making request from file

servers. Traditional Remote Procedure Call has resulted in an improper balancing of tasks among nodes in the network. Task requests are executed as they come and without consideration of the complexity (weight) of the tasks involved. This often resulted in poor or degraded performance of the distributed systems. Most of the previous works made use of traditional Remote Procedure call (RPC) when evaluating the performance of remote procedure call. In this model, calls are made to remote objects in order to carry out tasks, immediately the tasks are available. The model does not take into consideration the weight of the tasks to be carried out, which will normally result to load imbalance and hence a reduced performance in the use of the model. Many health information systems make use traditional Remote Procedure Calls (RPC) in retrieving data from file servers, Korpela et.al.(2005).

Many health information systems based on traditional RPC that are implemented in network environments can be re-engineered so that inter-process communications among nodes in the network are made faster when accessing patients medical information by utilizing the computing powers of the different nodes in a distributed computing paradigm. According to Famutimi et al. (2012), the response time and throughput of an RPC based inter-process communication can be improved for better performance. In the paper, an enhanced inter-process communication model for health information systems was presented. The aim was to achieve a faster patients information retrieval than the traditional inter process communication system without upgrading the available hardware. The paper is an implementation of a popular model in a health information based system. A Made in Nigeria Primary Health Information System (MINPHIS) database was used as the file server.

2   Literature review

Brandy, T. et al. (2010) worked on SmartGridRPC; The new RPC model for high performance Grid computing. The authors here worked on multiple tasks that are to be completed in parallel.   The tasks compared here are grid computing (that is rows and columns computing). The more the number of rows to be computed the higher the weight of that task. After introducing this intelligence into the Remote Procedure Call it was found to be efficient for high performance than the traditional Remote Procedure Call. This work was only based on grid computing of rows and column alone. It was also based on parallel tasks; it did not consider a situation where tasks are to be processed individually. In Manwade, K.B. & Patil, G.A. (2008), the authors here worked on parallel computation of tasks that can be computed in parallel. They applied mobile agents (MA) and traditional remote procedure call on parallel tasks. The performance Analysis of parallel RPC versus parallel MA model was obtained. The authors found out that RPC is better for small amount of data. Mobile agent is better for large amount of data. The authors did not consider an enhanced remote procedure call. A typical architecture a health information system, using a java based RPC scheme for inter-process communication between client nodes and server systems by Korpela, M. J. et al. (2005) is shown in Figure 1. The proposed model is to improve on the performance of the communication between the clients and the server that is using the transmission control protocol and the internet protocol (TCP/IP). Famutimi et.al (2012) proposed an enhanced inter-process communication model, which we are now implementing in this paper.

3   Methodology

Framework. In the implementation of the model, all nodes can both request for a query to be carried out on its behalf as well as carrying out a query task on behalf of another node. Database fields are taken as part of query keywords. In the distributed system, a program in node k, can be executed from any other node in the distribution. The complexity of a query is to a great extent proportional to the size of the keywords in the query (task). The keywords in a query are used to obtain the rank of a query. The processing capability of all nodes in the distribution has been earlier on determined through the use of system utility and ranges of query ranks allocated to each node in the node capacity registry.

Approach. The implementation consists of sequence diagram given by Figure 1, Use case diagram shown in Figure 2. class diagram in Figure 3 and Figure 4 as the flow chart of the implementation.

4   Results

When the enhanced model was evaluated with the traditional remote procedure call, the results were shown in table 1, table 2, table 3 and Figure 5.   Based on these results, the implemented enhanced procedure model resulted in an improved speed of patient health information retrieval.

In a distributed health information system, the speed of retrieval of patient medical information can be improved tremendously without resulting to frequent upgrade of system hardware whenever there is degradation in speed of patient information retrieval.
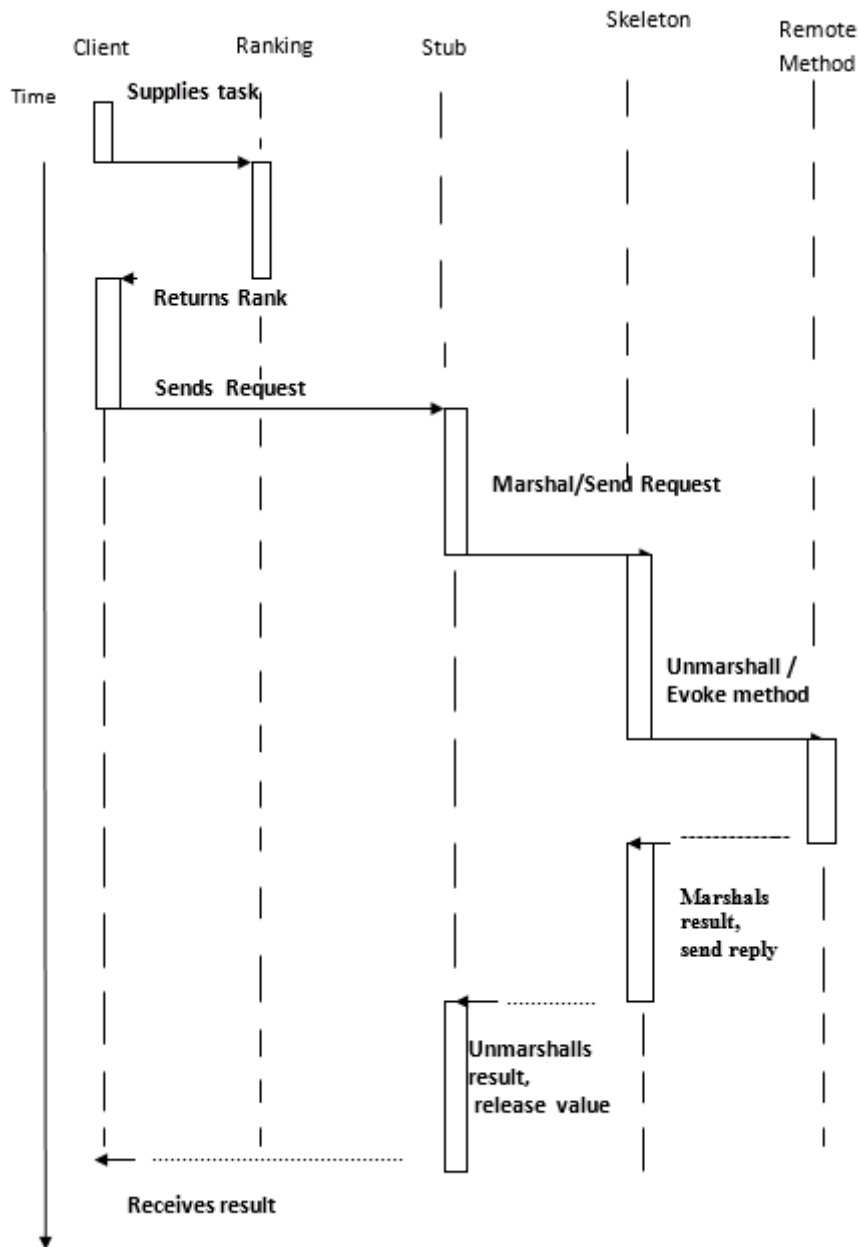
Figure 1. Sequence Diagram of the implementation (Famutimi et.al.,2012)
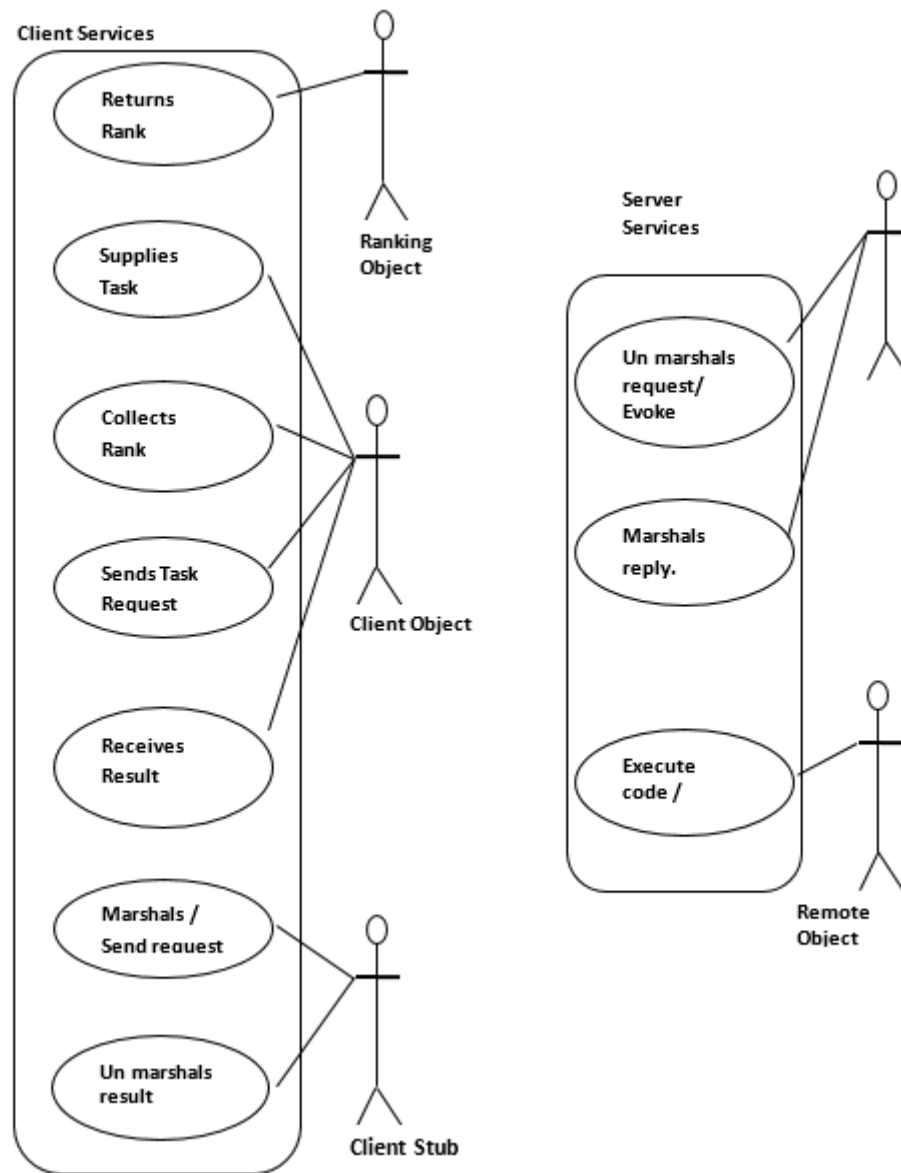
Figure 2. Use Case Diagram of the Implementation (Famutimi et.al.,2012)
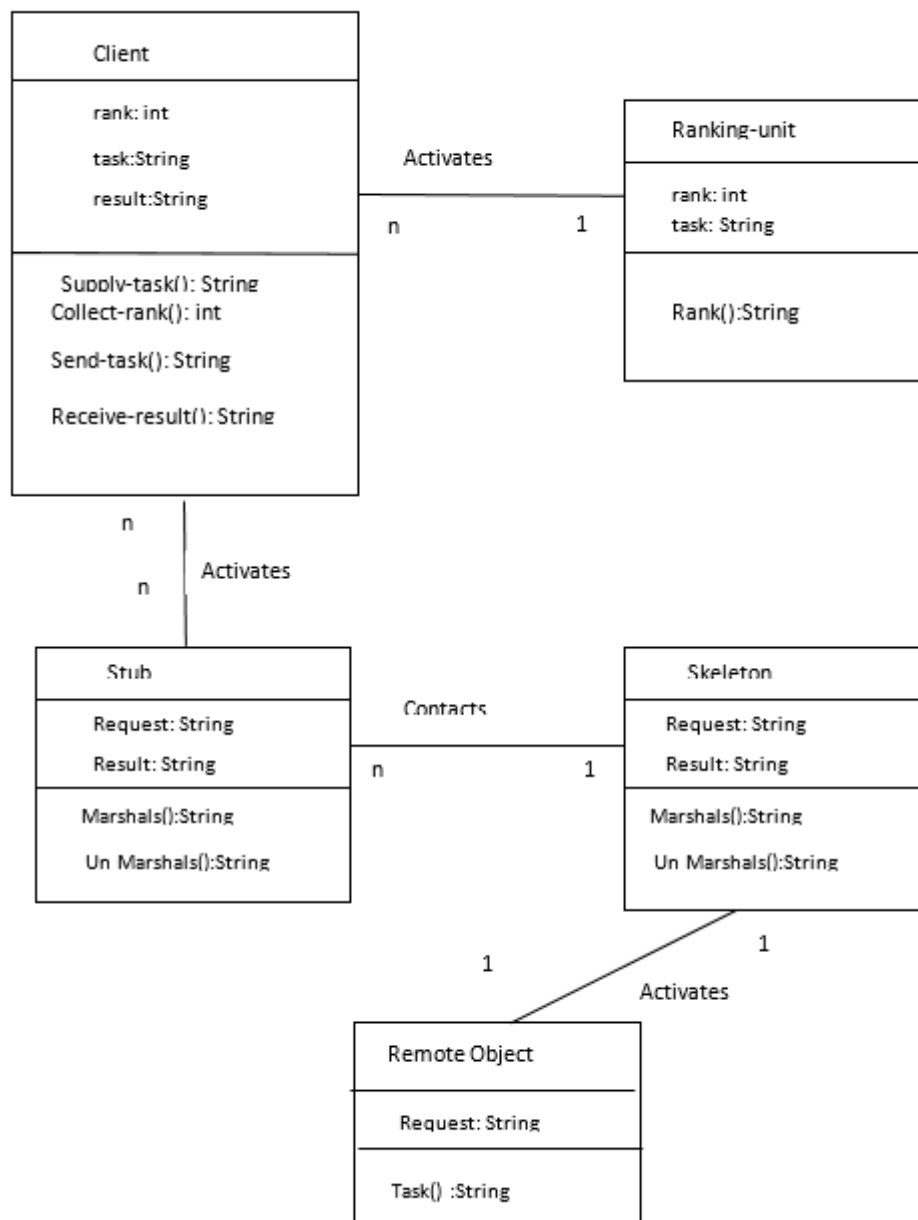
Figure 3. Class Diagram of the implementation (Famutimi et.al.,2012)
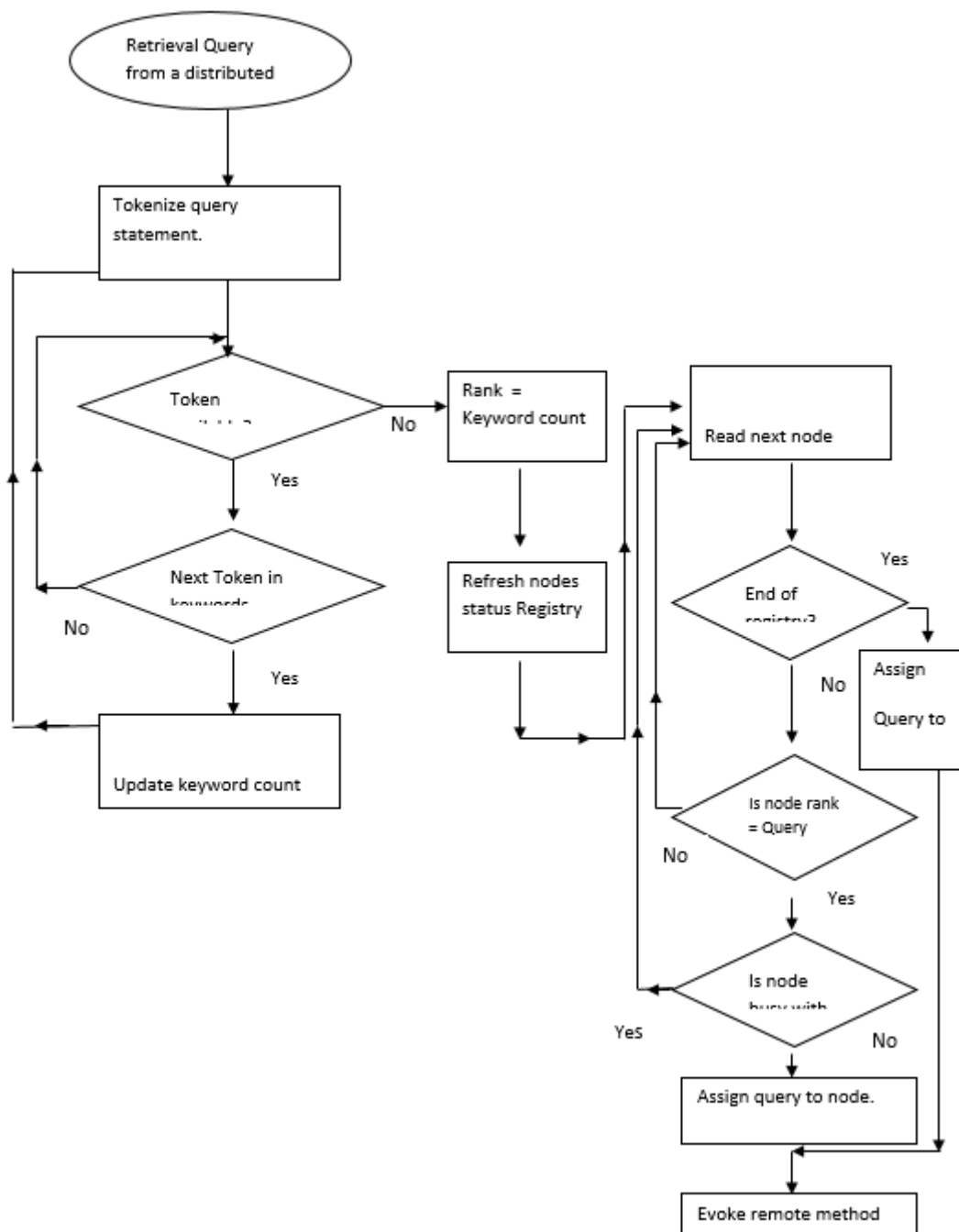
Figure 4. Flowchart of the implementation

Table 1. The result on traditional RPC

Runs	RANK/resp times(Mill secs)					
	IV	V	VI	VII	VIII	IX
1.	10	20	100	331	480	902
2.	10	30	100	310	450	812
3.	30	30	91	310	420	961
4.	50	30	100	311	450	952
5.	20	30	90	331	420	911
6.	10	30	108	311	440	881
7.	30	20	100	300	441	912
8.	10	30	100	310	441	912
9.	20	30	100	300	471	921
10.	20	20	100	331	490	931

Table 2. The result on Enhanced RPC

Runs	RANK/resp times(Mill secs)					
	IV	V	VI	VII	VIII	IX
1.	13	60	51	168	241	564
2.	36	23	45	94	237	528
3.	14	63	44	96	238	594
4.	11	18	46	95	260	528
5.	12	18	54	95	241	555
6.	11	21	41	96	239	556
7.	12	17	40	96	236	555
8.	12	17	43	97	231	513
9	10	18	45	96	241	523
10	10	16	43	93	242	526
AVRG	14	27	45	103	241	544

Table 3. Comparative speed of Traditional RPC model and Enhanced RPC

Rank	Traditional RPC model (Millisec)	Enhanced model (Millisec)	Speed improvement (Millisec)	Improvemetn(%)
4	21	14	7	50%
5	27	27	-	NIL
6	99	45	54	54%
7	315	103	212	67%
8	450	241	209	46%
9	910	544	466	51%
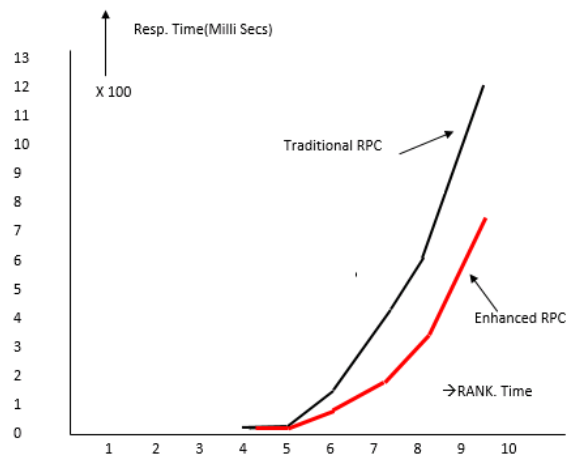
Figure 5. Comparison of Enhanced Remote Procedure Call with Traditional Remote Procedure Call using Response Time

5   Conclusion

In this paper, an enhanced inter-process communication model for health information systems has been implemented. Its aim was to show that a faster rate of patients information retrieval can be achieved using the proposed model. Significant improvement in speed was observed when the rank (items of retrievable data) was getting bigger.

Implications to practice.
The speed at which patients' information can be retrieved in an RPC based Health Information system can be speed up to an additional 50% or more of the present rate.
The rate at which RPC based Health Information Systems Hardware are being upgraded can be reduced in a distributed system when using this model, since high speed processing nodes can be made used of by other nodes .

Implications to policy.
In a distributed system, upgrade of specific computer nodes can be made use of by other nodes rather than embarking on general upgrade of all nodes whenever performance degradation is noticed. This will result in the conservation of resources used in distributed health information systems.

Future research direction.
The enhanced model which was RPC based, will be evaluated with a mobile agent that has been proven to be superior in performance to the traditional RPC model.

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Conceptual view of a data model for nursing process

[a]Yange Terungwa Simon, [b]Soriyan Hettie Abimbola and [c]Olaogun Adenike

[ab]Department of Computer Science and Engineering, Obafemi Awolowo University, Ile-Ife
[c]Department of Nursing Science, Obafemi Awolowo University, Ile-Ife

Object-Relational Database (ORDB) techniques are developed rapidly in recent years and widely used for temporal data storage and manipulation. The ORDB has strong basis both in theories and applications, and if well extended, it can also be used to handle temporal data. Although ample research on temporal data modeling has been performed, very little work exists on how to implement a temporal information in an ORDB. This paper aims at building a temporal data model for nursing process via extending object-relational database. The nursing process is a framework used by nurses during care delivery and consists of assessment, nursing diagnosis, planning of care, implementation of the care and evaluation phases. These steps are progressive and successive which forms a continuous cycle generating data that varies with time. Managing the data garnered during the implementation of this process is expedient. Hence, the computerization of the nursing process becomes difficult as the existing systems do not support time varying data.

Keywords: Nursing, Nursing Process, Temporal, Object-relational.

1   Background

Nursing as a discipline is dynamic and so is the data generated in the course of the activities. Time is very key in nursing since all the activities varies with time and hence, the data produced is temporal e.g. objective (signs) and subjective data (symptoms) collected by nurses. Nursing is a profession with a unique perspective on people, environment and health, and has moved from the medical model which focuses on the treatment and care of pathological illness/disease to a nursing model which emphasizes a holistic care [1]. Nurses are therefore accountable for what they do during client care delivery. This underpins the need for the effective implementation of the nursing process in clients care delivery. Though not all trained nurses use this framework especially in Nigeria [2] like in other developing countries of the world; since their activities are greatly monitored by physicians.

The nursing process is a modified scientific method of clinical judgment used by nurses in clients' care [3]. The nursing process is adapted from a problem solving technique used by nurses in their daily activities to help clients improve their health and assist physicians in administering care to clients. The nursing process is central to all nursing care; it encompasses all steps taken by the nurse in caring for a client. Its primary aim is to know the health status and the problems of clients which may be actual or potential. It is made up of a series of stages (assessment, nursing diagnosis, planning, implementation and evaluation) that are used to achieve the objective - the health improvement of the client. The use of nursing process can stop at any stage as deemed necessary provided the client need no care or can be repeated as needed [1]. As this process is repeated, new data is collected at every point in time; hence, its temporal nature.

Representing the transition states of the data collected during the implementation of client care, over different intervals of time, using the existing data models becomes difficult due to the fact that these models do not support changes in the states of data. Although nurses require both the past, the present and the future data about the client health status when making decisions, these systems faced rejection thereby forcing them to continue with the manual system.

Efforts to incorporate the temporal domain into conventional database management system for the purpose of addressing some of these issues have been ongoing for more than a decade, and dozens of

temporal models have been proposed and a few or none of them have been implemented [4]. Hence, designing effective, secure and useful nursing information system which handles temporal data is desirable despite its attending challenges for software developers.

This paper aims at designing a temporal object-relational data model called nursing care temporal object-relational (NC-TOR) data model.

2   Related Work

The five phases of the nursing process are assessment, nursing diagnosis, planning, implementation, and evaluation of the implemented care. These five phases are not discrete entities but overlapping continuing sub processes. This implies that these phases are not isolated but are intertwined and build on one another to achieve client needs. These five steps are the core of nursing actions in which quality nursing care is delivered to clients [5]. It should be noted that nursing diagnosis is different from the medical diagnosis in that the medical diagnoses focuses on the treatment of diseases, while the nursing diagnoses focuses on the client's health care needs [1, 3].

The steps of the nursing process are progressive and successive and this forms a continuous cycle of thought and action as shown in figure 1 [6]. It is client-oriented, goal-oriented, dynamic and cyclic, universally applicable, problem-oriented and cognitive processed. The nursing process is continuous for every client problem and care; each step is built on the previous steps and influences subsequent steps. For example, the nurse cannot develop a plan of care and select nursing interventions from that plan until valid nursing diagnoses have been formulated from an adequate database, which includes the client's perspective and input. Thus, the nurse cannot evaluate outcomes of care unless the desired outcomes have been specified as client goals or objectives in the care plan [7].

This implies that, while the nurse implements a planned intervention, such as pain relief measures, additional data may be collected that further validate and support the nursing diagnosis of pain, while also leading to the development of additional nursing diagnoses, such as a disturbance in the client's usual sleeping patterns. Thus, during any nurse-client interaction, the nurse is continuously collecting data that may then be helpful in planning, implementing, evaluating, or revising/modifying the plan of action (nursing care plan).

The nursing care plan is the blueprint for directing nursing activities, as a written guideline for implementing client care. This provides a mechanism for communication among health team members which can help to ensure coordinated, effective care for the client. By writing the care plan, a permanent record is made of the care the client should receive and what he/she actually has received. The nursing care plan, when properly written, will provide direction for the nurse in terms of the type and frequency of observations to be made, what nursing measures to implement and how often, as well as what to teach the client and family. The nursing care plan indicates what should be documented in the nurse's notes or progress notes. It also guides the nurse in evaluating the effectiveness of the care given to the client. Care plans facilitate nurses in delivering high-quality, consistent, and effective care [8].
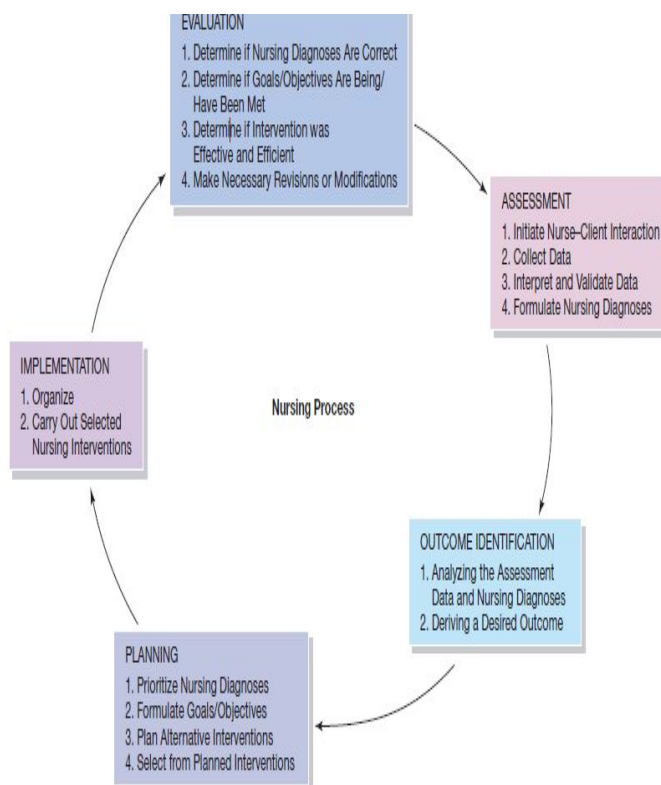
Figure 1. Nursing Process (Source: [6])

One of the most important applications of computers is storing and managing data. The manner in which data is organized can have a profound effect on how easy it is to access and manage. In every business, keeping daily transactions records is very important. Nursing is not an exception to this; much of the world's computing power is dedicated to maintaining and using databases to manage this effectively. Databases of all kinds pervade almost every business. All kinds of data, from emails and contact information to financial data, medical data and records of sales, are stored in databases [9].

The existing nursing information systems like Computerized Patient Information Systems-CPIS [10], Computer-based nursing Information System-CBIS [11], etc. handles only a single state of data. This makes it difficult for nurses to maintain and provide valuable care plan information throughout the nursing care process using such systems since this information is unstable due to the dynamic nature of the nursing process. Despite the problems, nurses still prefer managing their data manually. The reasons according to [12] are the inability to maintain reliable and accurate data for the planning of clients' care, no proper education of nurses on this aspect of technology; many hospitals do not have computers, etc. She further stressed that poor nursing information systems have delayed the progress of nursing services both within Nigeria and the world at large. According to [11,10,13,14], the existing systems are not acceptable or adopted by nurses because they do not include time dimension and also do not capture 'real nursing'. These researchers further affirmed that the computer-based information systems available lack the following features that contribute to quality care delivery:

1. Prompts or reminders within the period of care process (i.e., that is when to carryout assessments, diagnosis, plan for care, implement the care planned and evaluation)
2. Ability to collect real time nursing data
3. Standardized and streamlined diagnoses and interventions
4. Keeping of past and future records
5. Information retrieval from past visits
6. Provide reminders when part of the nursing process is missed.

By this, it is quite obvious that data collected during nursing process changes state with time as shown in figure 1; and most computer-based nursing information systems do not have the capability to manage this

data efficiently thereby deterring nurses from adopting them. This change in state (i.e., past, present and future) of the data collected during nursing process over time explains the temporal nature of nursing data.

In the conventional model the temporal behaviour of data has been largely neglected, being reflected only through updates while ignoring the previous states [15]. Relational data model can be extended to incorporate temporal relationship. In recent times lots of research has been carried out to extend the relational data model for incorporating time factor [15]. Two approaches were widely used: tuple/relation time stamping and attribute/field time stamping [17]. In relation timestamping the time stamp is a field of the relational model and hence it is associated with each record. [18] proposed temporal relational algebra based on multiple dimensional relation timestamping to capture the temporal dimension of data.

According to the survey carried out by [18], significant amount of work has been done in this area, various existing relational operators were redefined and other new operators were also proposed. Further a new query language like SQL was proposed to handle temporal queries.

Various temporal data models have been proposed based on temporal dimensions [19]. Some models are defined over valid time or transaction time while others are defined over both (transaction time and valid time). The valid time of a fact is the collected times-possibly spanning the past, present and future-when the fact is true in mini-world. Database models and records information about a part of reality, termed the mini-world [20]. Varying time thus captures the temporal state of real world. The transaction time of the database fact is the time when the fact is current in the database [21]. SQL-92 corrects some inconsistencies in the time support provided by the commercial database system, but inherits its basic design limitations.

An effort to consolidate approaches to temporal data models and calculus-based query languages has just been completed, achieving a consensus extension to SQL-92 and an associated data model upon which future research can be based. This extension is called the Temporal Structured Query Language [18]. Table I illustrates the various temporal data models, based on temporal dimensions and identifiers. Several object-oriented temporal data models were also proposed [20].

For Accurate nursing care process, there is need to define a data model with a structure that can handle regular updates of nursing repositories. This has a promise that the computerization, if properly done, will go a long way in enhancing nursing activities.

3 Implementing Temporal Databases Support in Conventional DBMS

Although, efforts to incorporate the temporal domain into conventional database management system have been ongoing for more than a decade, and dozens of temporal models have been proposed and a few or none of them have been implemented [4]. Incorporating the time dimension in a data model means that the implementation of the model of the DBMS must be altered as well. Since most DBMS can be considered as black boxes, the corresponding change of the software has to be done by the DBMS developer. Approaches of incorporating time-varying behaviour in conventional data models include building the temporal functionality into the database applications or using the extensibility inherent to some DBMS to support temporal data structures and behaviour. Basically, there are two main approaches of incorporating time-varying behaviour in conventional data models [25]: integrated and layered approaches. These approaches differ in the kind of support for time-varying data that can be achieved. In the integrated approach, the internal modules of the DBMS are altered or extended to support temporal behaviour i.e., modifying the source code of the DBMS itself. The layered approach on the other hand, interposed a software layer between the user-applications and a non-temporal DBMS that converts temporal query language statements into non-temporal statements that are subsequently executed by the DBMS, which itself is not altered [22]. While the integrated approach ensures maximum efficiency, the layered approach is more realistic.

The layered approach was employed in this research. The conventional DBMS (Object-relational DBMS) used supports facilities to implement abstract data types (ADT). It allows users not only to specify data structures, but also to extend the functionality of the system and to store it in the database. This is not possible using other DBMS models. An ADT can be implemented for time, including, for example, data structures for sets of time intervals and operations to calculate the union, intersection and difference of sets of time intervals as proposed in [23, 24, 25]. This ADT then can be used to build temporal semantics into application programs.

4   Methodology

In order to achieve the aim of this paper, a survey of existing temporal data model was carried out. The temporal model was designed using entity relationship diagram (see figure 2). The architectural view of the model is designed using Enterprise Application Diagram shown in figure 3.

5   Results

The data model designed was implemented using the database structure shown in figure 4. This modelled the time-varying nature of nursing data. The model took into cognizance the temporal nature of data collected by nurses during the delivery of care to patients which make it possible to keep past, present and future records. It creates a template to create a knowledge base for nursing which will aid in the proper implementation of evidence-based nursing, nursing research, nursing education, etc. The platform also automate the development and implementation of nursing care plan; and the management of the data collected in the course of administering care to patients.

6   Discussion

NC-TOR data model comprised of four major components as shown in figure 2-the nursing process, the temporal translator, data access layer and the object-relational database management system server. The architectural view for the model is shown in figure 3 and detailed out the components of figure 2. This is discussed below.

Assessment: This point captures the client's objective (signs) and subjective (symptoms) data. The client's nursing history and orders from other health care team are also considered. The Gordon's health functional pattern was used to structure the data collected.

Diagnosis: Here the data collected from the assessment stage was analyzed to identify the client's problem/need. This was based on the NANDA International (NANDA-I) diagnoses. This also determined the expected outcomes based on the nursing outcomes classification (NOC) outcomes. The time at which this is done is very important and therefore it is timestamped with both transaction time and valid time using tuple timestamping.

Plan: The diagnoses were first prioritize using Maslow's Hierarchy of needs and the care was planned. The list of interventions to achieve the defined outcome was also specified which were based on the NIC interventions. Time was also apportioned to each stage in the care plan i.e., when to administer the care and to go for evaluation. Other nurses were also delegated to implement the plan as the case may be. This was also timestamped using tuple timestamping with both valid time and transaction time.

Intervention: The actions specified in the care plan were executed at this stage. For each step taken, the time at which it was administered was captured and the time during which it was observed was also captured. This step was also timestamped using tuple timestamping with both valid time and transaction time.

Evidence/Evaluation: The nurse observes the client and in the course of this observation (assessment), more data was collected i.e., both objective and subjective data; and the actual outcomes are determined based on nursing outcomes classification (NOC) outcomes. This determines whether the care should continue, modified or terminated as the case may be. This was also timestamped using tuple timestamping with both transaction time and valid time. The timestamping of data with both valid and transaction time by this model is what makes bitemporal.

Client: The client is the chief complainant.

Nurse: This refers to the nurse which collects the temporal data from the client using the five steps of the nursing process. Basically, we consider a registered nurse as the head of the team which carry out this task.

User Interface: The part of the system/terminal that accepts commands from and returns information to the user (nurse). This is either at the bedside of the client or the nurses' room.

Application Process: This contains the logic of the application that implements the model. Since layered approach of extending conventional databases was employed, the logic about the extension of the object-relational database (PostgreSQL) was developed here. At this component, the abstract data types

(ADT) for the temporal data were defined. These include the three (3) main temporal data types: interval, instant and period which were used to timestamp the data collected during nursing process. These classes inherit the properties of the Time Dimension class. An instant is an anchored location on the time line.
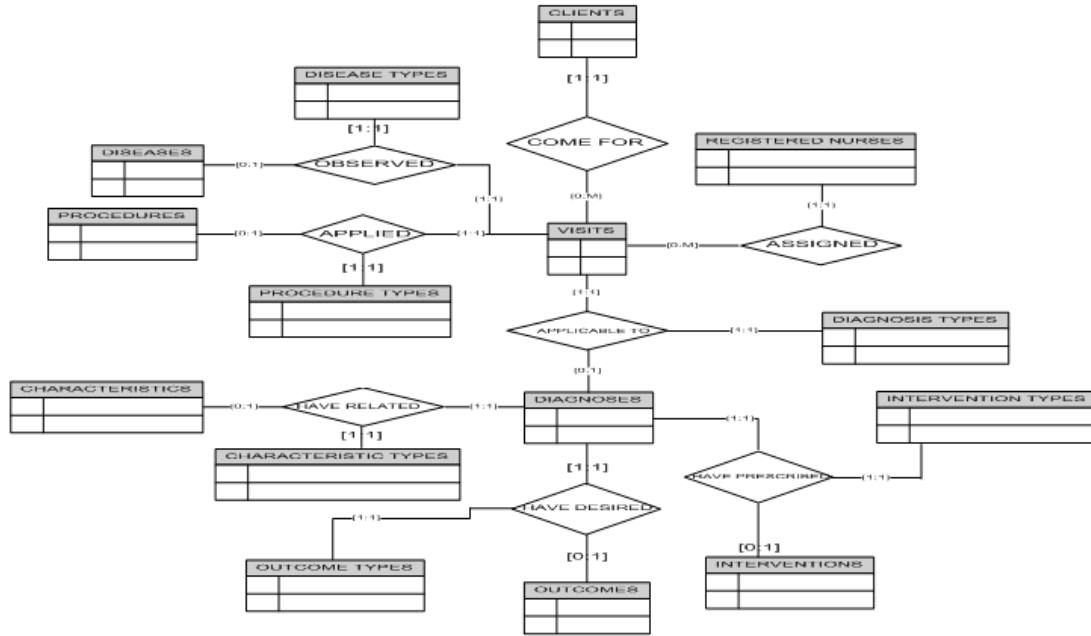
Figure 2. Data Model
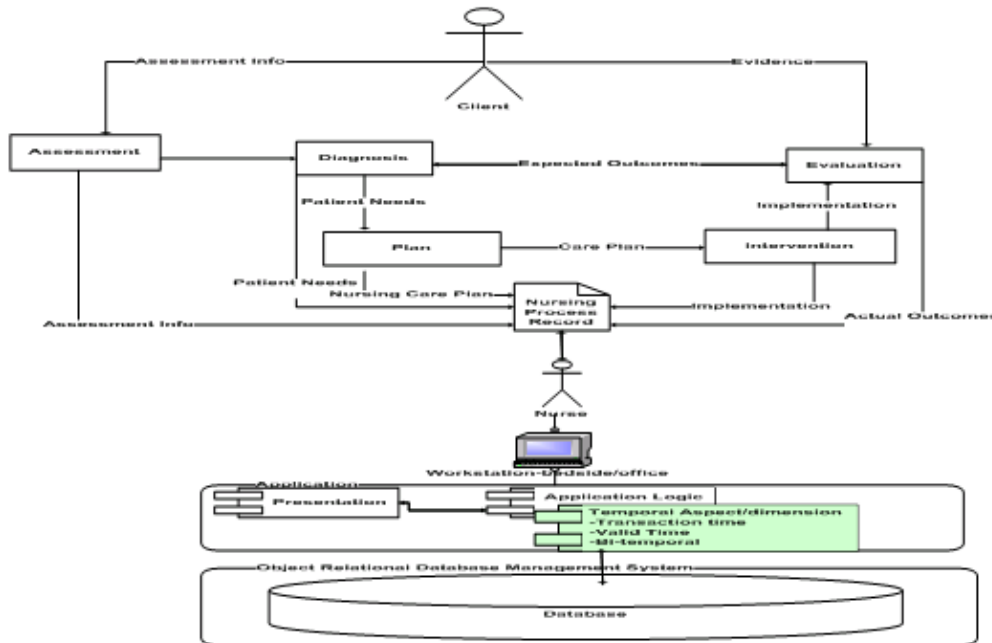
Figure 3. Architectural View of the Model
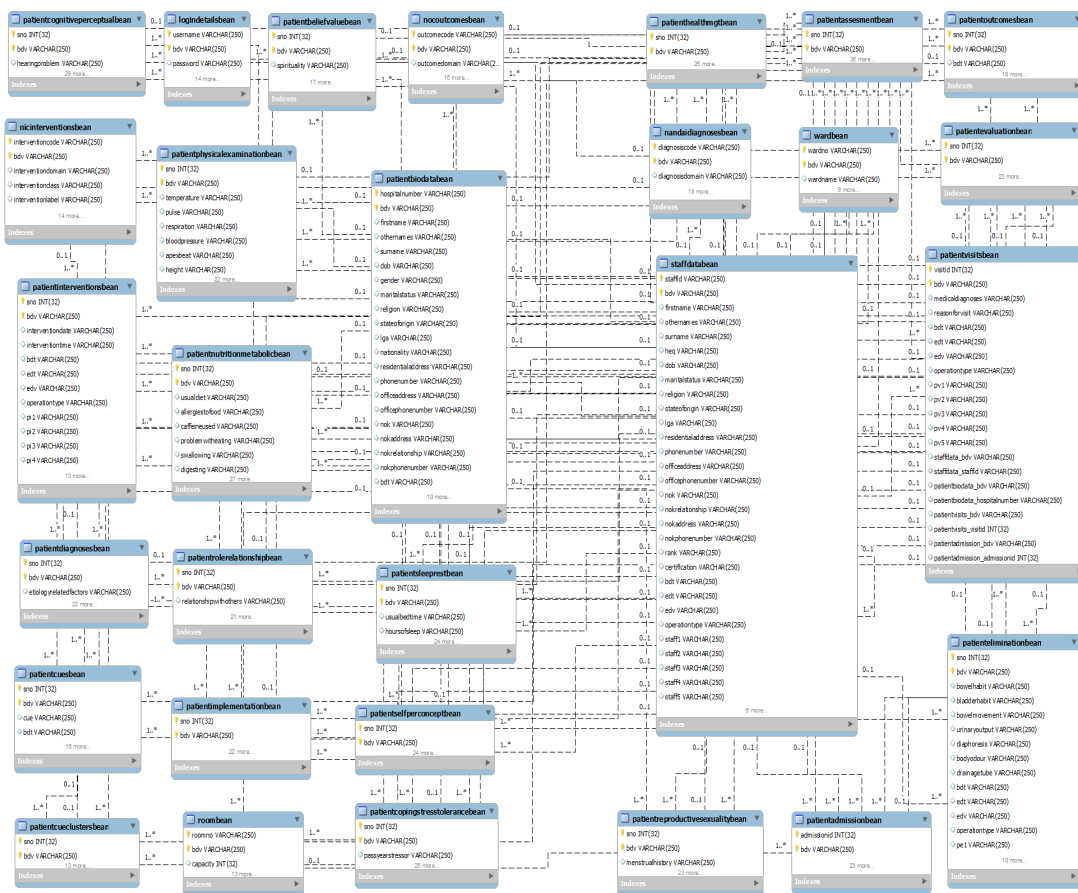
Figure 4. Database Design for automated nursing processing

For instance, the care plan was written on the instant of 2:38 P.M., August 14, 2013. An instant occurs but once, and then is forever in the past. This data type is most fundamental. An interval is an unanchored contiguous portion of the time line. An interval is relative; an instant is absolute. An interval can be added to an instant, yielding another instant. The distance between two instants is an interval. Unlike instants, intervals have direction. An interval can be positive or negative, denoting a shift to the future or to the past respectively. A period is an anchored duration of the time line. The care plan comprises the period from August 25, 2013 to September 19, 2013. This makes the definition of valid time, transaction time very easy; and also very flexible to manipulate. The java programming language is used to create and manipulate these data types.

Temporal Translator: This translates the queries into the format that can be easily defines for the ORDBMS. The temporal translator is the software component/module acting as a client application to the ORDBMS.

This translate the temporal data types such as intervals, instants, now, between, periods etc. defined in the application process for the data access. This is accomplished by associating time with facts. It captures the complex semantics of time by representing it as a basic entity. All requests sent from the nursing process component are scanned at this point. This is checked for the correctness of the syntax of the request. This then removes unwanted information specified in the request and the data is also timestamped at this point using tuple timestamp. The request is also translated into the form that can be easily defined for the database. The translated request is then check properly before passing it to the data access layer and vice versa. The temporal translator also monitors the database server through the data access layer to know when it is time to administer care to a particular client so as to alert the nurse in-charge (or the delegated nurse) either through email or short-message service (SMS) alert or on-screen popup messages as the case may be. This is achieved by using rule-based approach. The desired behavior was expressed in production rules (also called event-condition-action rules), which are defined using

ADT. Temporal events i.e., events that were triggered by time, type-specific events (method invocations), object creation, object deletion, etc. At any point in the process, if there is an error, the system send back an error message to the interface.

Data Access: This defines access in the native format of the Object-Relational DBMS, PostgreSQL.

DBMS: The Object-Relational Database server, PostgreSQL. This makes it easy to extend the capability of DBMS to incorporate complex data structures and implementing function defined by the user.

7   Conclusion

In conclusion, temporal data models records the time varying aspect of the real world. Different temporal models and approaches of incorporating temporal behaviour in conventional database were studied. Also, the design of a conceptual temporal object relational model for managing nursing process with respect to the effective usability of the information acquired.

Acknowledgements

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A viable architecture for the integration of a recommender system and mobile solution for the management of HIV/AIDS

Adekunle O. Afolabi [a,b,*], H. Abimbola Soriyan [a], Juha Mykkänen [b], Pekka Toivanen [b] Mikko Korpela [c]

[a] Department of Computer Science and Engineering, Obafemi Awolowo University, Ile-Ife. Nigeria
[b] School of Computing, University of Eastern Finland, Kuopio, Finland
[c] Cape Peninsula University of Technology, Cape Town, South Africa

Background and Purpose: Mobile devices are a common sight everywhere in the world with attendant phenomenal growth in various ways. As a result of their mobility, there has been an increase in penetration among different cadres of people regardless of their social or economic status in the society, thus bringing about changes in the ways businesses are done in commerce, economic and health sectors. Recommender systems in medical and healthcare context are emerging significantly with attendant positive impacts on the speed and accuracy of diagnosis. A few successful implementation of such recommender systems alongside few with good results have been highlighted in literature. However, HIV/AIDS have also become endemic in most developing countries with victims being afraid to openly seek medical care because of stigmatization. As a result of mobility and a degree of privacy that mobile devices ensure combined with the ability of recommender systems, interactive solution is desirably helpful in providing care for infected individuals, who especially are reluctant to seek medical care due to stigma. survey conducted on the potential of mobile phones for counselling HIV/AIDS patients shows over 80% comfortable discussing health issues (including HIV status) via mobile phone before face-to-face contact. This is an indication that mobile devices have the ability to play a vital role in HIV/AIDS patients' management. A further analysis of the survey revealed key attributes of a desirable architecture and these have served as a basis for developing the architecture presented in this paper.

Methods: Questionnaire was used to gather information from potential users who are drawn from the group susceptible to the malaise, 250 youth and health workers from the ages of 18-50. Respondents were drawn from students in a university in Osun State Nigeria and health workers in a nearby hospital. The result was further analyzed and key attributes were extracted with a view to identify relevant components for the proposed architecture.

Results: survey conducted on the potential of mobile phones for counselling HIV/AIDS patients shows over 80% comfortable discussing health issues (including HIV status) via mobile phone before face-to-face contact A further analysis of the survey revealed key attributes of a desirable architecture and these have served as a basis for developing the architecture presented in this paper.

Conclusions: It can be seen from the result of the survey, its further analysis and the presented architecture that mobile devices have a role to play in the management of HIV/AIDS, and is more effective when integrated with dynamic recommender systems.

Keywords: System architecture, Mobile health, Recommender systems, Health information system, HIV/AIDS

1 Introduction

HIV/AIDS-related stigma, which includes prejudice, discounting, discrediting and discrimination directed at people perceived to be living with HIV or AIDS is a major barrier toward better care for those infected [1, 2, 3, 4, 5]. Besides, those who provide direct services to individuals effected also suffer stigma [6]. The rate of prevalence among the most vibrant population (15-49) is alarming and the effects of HIV/AIDS epidemic on economy are slow or reverse economic growth, reduction in savings and investment of families because of increase in expenditures of HIV/AIDs related issues, diversion of public spending from investment on human and capital to health, and increase in poverty rate [7, 8, 9].

Globally 35.3 million people were living with HIV in 2012 with Sub-Saharan Africa home to 70% of all new infections [8]. Among the problems responsible for the prevalence is lack of access to medication and good counselling which is due largely to prejudice and stigmatization [8].

Besides their common use in other sectors of the economy, Mobile devices have become a ready and effective tool in healthcare, especially for monitoring, delivery and sometimes management. There have been efforts to provide effective solutions for mobile health in the broad context of cost reduction and just-in-time services (such as in [10]). However, HIV/AIDS have also become endemic in most developing countries with victims being afraid to openly to seek medical care because of stigmatization. The use of mobile devices in assisting care of HIV-infected individuals have also been documented. Such interventions is seen in its use to help infected individuals to adhere to treatment [1]. In a project tagged "Cellphones4HIV", conducted in South Africa, three pilot projects were examined to see how mobile technology can be used in the prevention, treatment and care of HIV and AIDS, and to support the HIV sector in general [5]. An integrated mobile platform will be necessary to achieve the desirable objective of an interactive health management for persons living with HIV/AIDS. Broadly the common features of the proposed system from the viewpoint of users and experts will be determined to make the entire system useful and transformative following integration with the existing Hospital Information systems.

Recommender systems in medical and healthcare context are emerging significantly with attendant positive impacts on the speed and accuracy of diagnosis. A few successful implementation of such recommender systems alongside few with good results have been highlighted in literature [8, 11, 12]. Although many of these system have built in them some form of intelligence but may not have the ability to make automatic recommendation based on its learning capacity. Some diseases change symptoms (e,g, cancer, HIV/AIDS) as they progress to maturity or get worse, it is a great service in the treatment and management of such illnesses when treatment and management recommendations are made based on this progression. Such recommendations are also based on the past activities or requests of primary users (patients, relatives or other care givers) and the activities or requests of others who are suffering similar chronic illnesses

2   Materials and methods

The study is divided into three different phases. The first phase involves conducting survey on the perception of intended users of the system on the effectiveness of the mobile phone for management of HIV/AIDS. This is not just about whether they think mobile phones can be used for counselling HIV/AIDS patients but what features they expect the proposed system to have. The features gathered from the first survey will be subjected to further refinement using both expert and users experiences. These features are ranked in the order of importance by the expert and preference by users. . Questionnaire was used to gather information from potential users who are drawn from the group susceptible to the malaise, 250 youth and health workers from the ages of 18-50. Respondents were drawn from students in a university in Osun State Nigeria and health workers in a nearby hospital.

In the second phase the result of the survey was analyzed and key attributes were extracted with a view to identify relevant components for the proposed architecture. The third and final phase is to propose an architecture that will allow interaction between an infected individual and the consultant via mobile device.

3   Results – What the questionnaire study reveals

This is work in progress and so far the first part of the first phase in underway. The survey has been carried out to determine users' perception on the effectiveness of mobile phones in the management of HIV/AIDS patients. The result shows that 70% of the respondents prefer mobile phones as a medium of counselling when it comes to HIV/AIDS while 80% feel comfortable using phones for consultation. These ones feel so because they think mobile phone is portable and conceals their identity. Besides the normal interactive features of the systems, the result shows that users would like to have the following additional features; checkup reminder, health information update, information about drug and its availability, prevention and support, and clinic attendance.

The analysis of the survey conducted gave insight into the needs of the intended users and the requirements for building a viable, usable and useful system. This however may benefit from further refinements, especially when the architecture is fully implemented in the challenging contexts. The following inferences are drawn from the analysis of the survey based on the aim of the research.

(a) **Users are comfortable discussing confidential matters over phone as long as they are sure the person on the other side can be trusted.**
   The result of the survey indicated that phone is a least known device for receiving interactive counselling. Although a greater percentage (96.7%) of the respondents indicated that they had not received any formal counselling through phone but 53.7% of the same population agreed they would feel comfortable discussing some personal matters on the phone as long as they are sure that the other person can be trusted.

(b) **Phone is useful for an initial contact to build confidence and learn.**
   Since all the respondents have phones and have been using them for a while, some 62% agreed they were able to build confidence in their friends after discussing together over the phone even before they were able to personally meet. This clearly indicates that confidence can be built even if contact has been majorly through phone.

(c) **Updates are desirable (a recommender system has a role to play).**
   This is a key issue from the analysis of the result of the survey. More than 80% of the respondents would like to have update concerning their health issues. This ranges from checkup reminder to information about drug and recent breakthroughs in treatment and management of ailments such as HIV/AIDS.

(d) **Organizations are to play key roles.**
   Arising from the issues discussed above is the need to have organizations play key roles in making the counselling and management of terminal ailments easily accessible and location-independent. Local, national and international organizations have vital roles to play. However, the roles of other stakeholders may become clearer during system appraisal in challenging contexts (such as in low resource bloc). Other pertinent issues arising from the survey are the cost (who is paying for what), security and the kind of support needed (social, financial and professional).

4   Discussion

The aim of this project has been to come up with an architecture for implementation of a system for management of HIV/AIDS via mobile phones. The result of the survey has shown to a large extent that many of the people susceptible to HIV/AIDS are willing to allow consultation through the mobile phone. One basic reason for the choice is confidentiality and privacy because the phone conceal their identity for a while until enough confidence is built to see the consultant face-to-face. Another reason given for the choice is the ease with which the device can be deployed. They are also happy with the location-independence attribute of the device. The majority of the respondents are familiar with phone and spent an ample time using it. The respondents in this category are the target users of the system. Their input has also contributed to the development of the proposed architecture discussed below.

Architecture for Mobile Management of HIV/AIDS

Figure 1 shows the proposed architecture of the Management component of the integrated architecture. In this architecture there are hospital organization, the international organization, and the users as an entity. The user interacts with the both organizations through the consultant via the mobile device. If the infected person has not built enough confidence with the counsellor, then the identity is uniquely coded. The data with the unique code is kept in the temporary data storage virtually created and accessible to the

consultant or counsellor only. The hospital information system is available to provide background medical history of identified individuals who are registered at the hospital.

The hospital is recognized at the organization providing the services of the counselling and management via the mobile phone. The provider or the consultant is registered with the hospital and therefore can use its resources and access patients records kept based in the hospital in offering this service. The temporary data storage (database) is provided for the provider to enter the data of the infected person seeking counselling. This may be necessary for two reasons: (1) to have the records of the individual for reference until he seeks medical attention at the clinic, (2) to help the provider give adequate help having reviewing the given information on another contact day. This data may be merged with his record in the hospital information system at a later date.
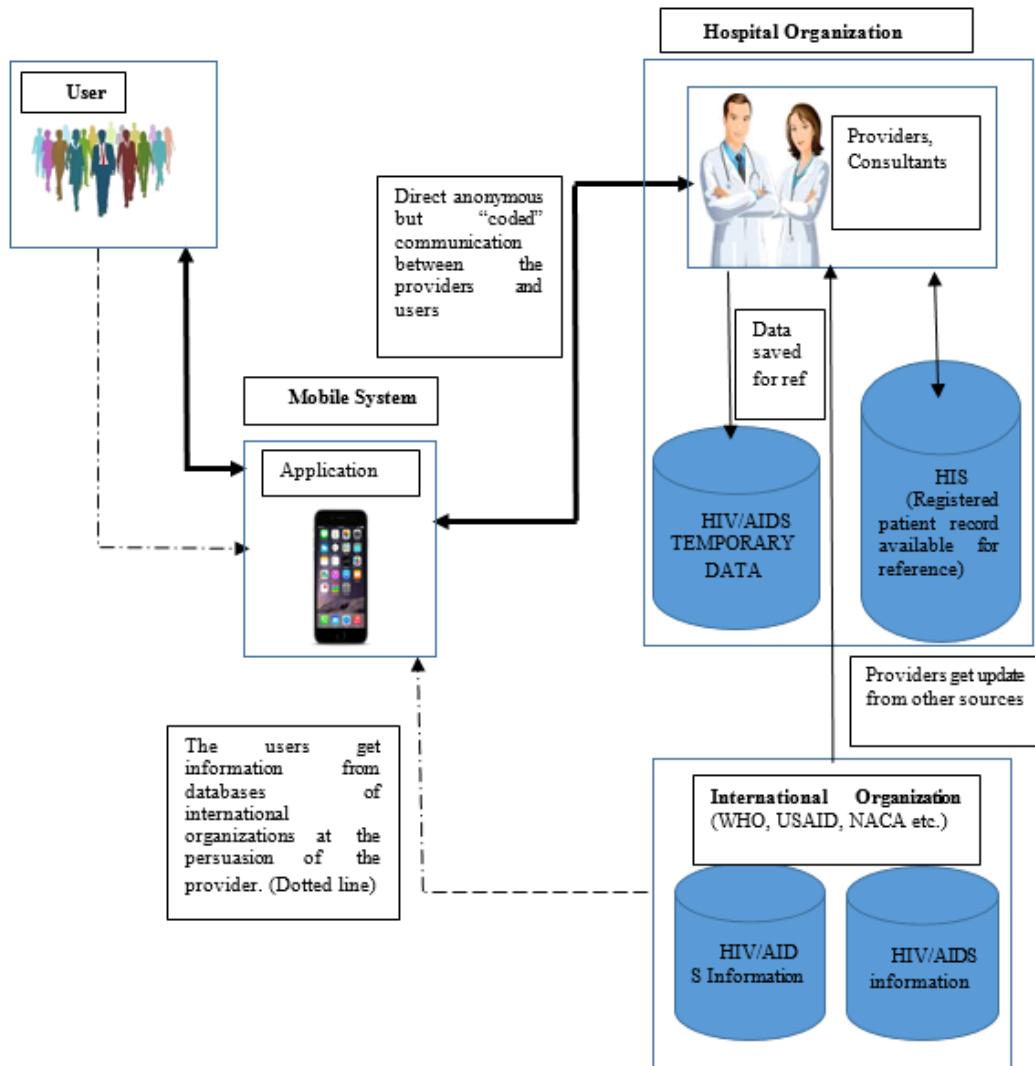
Figure 1. Proposed architecture for Mobile Management for HIV/AIDS

However, since the result of the survey indicated the need for update on new treatment and management methods including drug, the need to integrate other sources of getting the desired update. This sources should be more liable than just searching through the Internet. The information should have professional undertone. Hence the incorporation of databases from reliable National and International organizations such and the WHO, USIAD, NACA among others. The hospital organization makes this available to the provider working within their organization, or has it may be, the provider access them directly as a registered professional in the field.

No doubt the update from national and international health and HIV/AIDS- related organizations can be very useful and helpful in assisting and counselling the infected individuals. Effective treatment and management procedure followed by others may also prove very useful. This informs the integration of another component with the architecture presented in Figure 1, as shown in Figure 2 and discussed in the following section.

Proposed Integrated Architecture of Recommender System and Counselling System

Figure 2 shows the proposed architecture for the integration of dynamic Recommender system and the HIV/AIDS management system showed in Figure 1. The HIV/AIDS management system architecture has been described in the earlier section. However, the integration is done in order to allow for more effective and useful update. With the aid of a dynamic recommender system, the provider can search for and automatically receive update that will help in providing professional counsel on treatment and wellness procedure. With the integration, the user may also get direct update from the recommender system.
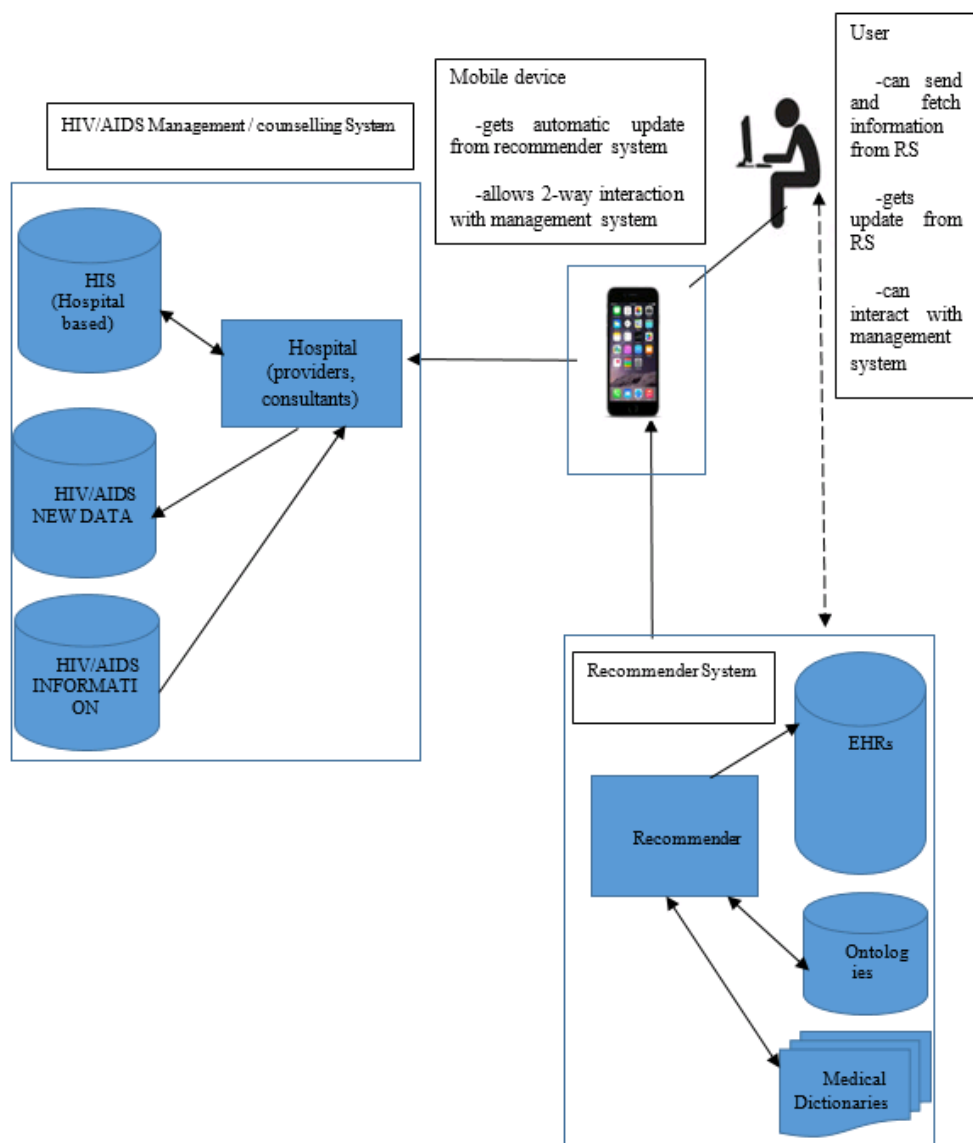
Figure 2. Integrated Recommender System and Management system Architecture

5   Conclusion

Prevalent stigma toward individuals living with HIV/AIDS is a major roadblock toward achieving the desired care for those in this situation. Hence many of them are reluctant to come to the open to seek the necessary care despite the attendant effects of this on human survival and economic growth. However, with increasing penetration and mobility of mobile devices along with some degree of privacy they offer, it is possible to provide care for the teeming population of people living with HIV/AIDS.

An architecture detailing an integration of a dynamic recommender system and mobile management system has been developed from the analysis of the research conducted. While the issues of cost and support remain as challenges to be overcome in the future the implementation of the architecture in both developed and challenging contexts may further expose other key characteristics that will enhance a refined architecture.

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Une stratégie d'implémentation de systèmes intégrés pour la gestion d'informations des structures de soins en République Démocratique du Congo

SHAMASHANGA Pierrot[a*], AMISI Clément[b], KARARA Gustave[c], VERBEKE Frank[c]

[a] CEMUBAC, Kinshasa, DR Congo
[b] Université de Kinshasa-UNIKIN, Kinshasa, DR Congo
[c] Vrije Universiteit Brussel – VUB, Brussels, Belgium

Contexte et objectif : Conscient des avantages qu'offrent les NTIC dans la gestion de l'information des structures de soins, le Ministère de santé publique de la RD Congo a choisi de se doter d'un Plan National de Développement Informatique de Santé (PNDIS). Ce plan devra lui permettre de récupérer son leadership dans le domaine de l'informatique et de coordonner ainsi l'informatisation du secteur qui était laissée aux bailleurs de fonds.

Méthodes : Pour arriver à proposer cette stratégie, nous avons procédé à l'analyse de l'existant. Ce qui nous a permis d'élaborer les architectures métiers, applicatives, des données et technologiques. Il s'en est suivi l'analyse des opportunités, défis et solutions, la stratégie de migration, de planification, de l'implémentation et de la gouvernance.

Résultats : Malgré la complexité de la situation en RD Congo, la mise en place des systèmes intégrés pour la gestion d'informations des structures de soins est une nécessité. Il existe déjà des solutions dans certaines structures qui nécessitent d'être capitalisées et dupliquées dans d'autres structures. Les technologies disponibles se prêtent à cet exercice.

Conclusion : l'implémentation de systèmes intégrés pour la gestion d'informations des structures de soins passe par les NTIC. Ces dernières permettent à terme à rationaliser le fonctionnement de ces structures et même l'amélioration de la qualité des soins.

Mots clés : Implémentation, Systèmes intégrés, Gestion de l'information, Structures de soins, République Démocratique du Congo

1   Introduction

Le système de santé RD Congolais est composé de trois niveaux distincts : le niveau central, le niveau intermédiaire et le niveau périphérique [6]. Chaque niveau dispose de structures de soins qui sont intégrées dans le système. Ainsi, au niveau central nous trouvons les structures de référence nationale et les hôpitaux universitaires [4,6], au niveau intermédiaire, les hôpitaux de référence provinciale et au niveau périphérique, les hôpitaux généraux de référence, les centres de santé et éventuellement les centres de santé de référence et postes de santé [6,11].

L'implémentation de systèmes intégrés pour la gestion d'informations des structures de soins a pour objectif d'améliorer la disponibilité et l'utilisation de l'information sanitaire pour la prise de décision à tous les niveaux de la pyramide sanitaire [2].

La disponibilité de l'information et l'utilisation de celle-ci pour la prise de décision est le résultat attendu du renforcement de tout système d'information sanitaire. Ce renforcement ne devrait pas se passer des nouvelles technologies d'information et de communication (NTIC) en pleine expansion. En effet, l'usage des NTIC a aujourd'hui gagné tous les secteurs d'activité de l'homme et le secteur de santé ne peut pas être à la traîne de cette évolution signant le passage de l'ère du traitement manuel de l'information à une nouvelle où l'information est de plus en plus automatisée [12].

Les NTIC offrent des solutions pour rendre disponible cette information sanitaire à tous les niveaux du système de santé, d'en améliorer la qualité, d'en faciliter l'utilisation et les échanges entre les différents acteurs du système.

Les conclusions des études de cas réalisées dans six pays membres de l'OCDE (Australie, Canada, Espagne, Etats-Unis, Pays-Bas et Suède) ont mis en évidence d'autres avantages de la mise en place des NTIC dans le domaine des soins cliniques [5]. Ces avantages sont notamment :

— L'amélioration de la qualité des soins et le renforcement de l'efficience ;
— La réduction des coûts de prestation des services cliniques ;
— La réduction des coûts administratifs ;
— La possibilité de mettre en place les modes de soins entièrement nouveaux.

Les gouvernements des pays reconnaissent que l'intégration des NTIC est une priorité en vue du développement des systèmes de santé [1]. Ainsi, la présente étude avait pour objectif de procéder l'inventaire de besoins et solutions existant dans les structures de soins en vue de l'implémentation de systèmes intégrés pour la gestion de leurs informations.

2   Matériels et méthodes

Le Ministère de la Santé Publique (MSP) de la RDC a lancé en juin 2014 une étude sur l'élaboration d'un Plan National de Développement Informatique de la Santé (PNDIS). L'objectif était d'établir une architecture entreprise e-santé pour le MSP. Une analyse exhaustive du fonctionnement du système de santé et des besoins en informatisation des structures de santé a été réalisée [10]. Dans cette étude nous nous sommes appesantis sur l'analyse faite la stratégie d'implémentation de systèmes d'information intégrés dans les structures de soins dans le cadre du PNDIS. Les informations présentées dans cet article ont été obtenues grâce aux visites et interviews semi-structurées réalisés aux différents niveaux de la pyramide du système de santé de la RDC :

— Au niveau des Directions du Secrétariat Général et des Programmes Nationaux,
— Au niveau des Divisions Provinciales de la Santé (DPS) et des hôpitaux provinciaux
— Au niveau des Zones de Santé (ZS) et des Hôpitaux Généraux de Référence (HGR)

Les provinces qui ont été visitées sont reprises dans le tableau suivant :

Provinces	Nombre de zones de santé	Nombre d'hôpitaux
Bas-Congo	5	6
Katanga	12	14
Nord-Kivu	10	13
Kasaï Occidental	18	20
Province Orientale	10	12
Total	55	65

Les critères d'accessibilité et de similarité avec les autres provinces ou zones de santé ont guidé ce choix. Il s'agit donc d'un choix raisonné. Au total 10,6% des ZS et 10,4% des hôpitaux ont été visités. The Open Group Architecture Framework (TOGAF) est la méthode qui nous a permis d'analyser les résultats [9].

3   Résultats

3.1   Phase préliminaire

Les sources d'informations importantes utilisées pour le développement du plan préliminaire ont été:

— Le Plan National de développement Sanitaire (PNDS, 2011-2015)
— Le rapport technique du Plan National de Développement de l'Informatique de Santé (PNDIS, Oct 2014)
— Le recueil des normes de la zone de santé (2011).

La vision actuelle du Ministère de la santé de la RDC est l'installation des systèmes d'information pertinents dans les établissements des soins qui puissent répondre prioritairement aux besoins des prestataires et gestionnaires de ces structures.

3.2   Architecture métier

Le système national d'information sanitaire est défini comme étant un ensemble organisé de structures, d'institutions, de personnel, de méthodes, d'outils et d'équipements permettant de fournir l'information nécessaire à la prise de décision, à l'action, à la gestion des programmes et de systèmes de santé à tous les niveaux : central, intermédiaire et périphérique [10]

La déclaration de la politique du Ministère de la santé en matière de gestion de l'information sanitaire énonce six principes directeurs de développement du système national d'information sanitaire dont le sixième préconise l'utilisation de nouvelles technologies d'information et de communication [3]. Dans les institutions hospitalières, l'implémentation de systèmes intégrés pour la gestion sera axée sur [10] :

— La gestion du dossier patient avec une identification unique du patient au sein de l'hôpital, une gestion détaillée du dossier administratif, de son histoire des consultations et hospitalisations, une gestion des informations cliniques, pharmaceutiques, laboratoires et d'imagerie médicale et la gestion du dossier de médecine préventive ;
— La gestion financière complète, de la gestion des données d'assurance maladie à la comptabilité générale et analytique, le planning et le suivi du budget de l'hôpital ;
— La gestion du laboratoire couvrant les demandes des laboratoires, l'identification et la réception d'échantillons, la gestion des listes de travail, la production des résultats d'analyses, la validation technique et biologique des résultats, la distribution des résultats aux médecins prescripteurs, le calibrage des équipements et le contrôle de qualité par rapport aux méthodes d'analyse appliquées ainsi que la gestion des stocks des réactifs ;
— La gestion de l'imagerie médicale allant de l'encodage des demandes d'imagerie, la gestion des liste de travail et la planification des examens à la production des images et rapports radiologiques ainsi que leur distribution aux médecins prescripteurs ;
— La gestion des archives des dossiers patients s'impose pour permettre un suivi médical longitudinal et holistique de chaque patient ;
— La gestion des activités préventives et d'éducation ;
— Le rapportage et la production des statistiques sur les activités de l'hôpital dont la production des données dans le cadre du SNIS hospitalier ;
— Le manque d'expertise en médecine spécialisée dans la majorité des structures de soins en périphérie révèle un besoin réel des solutions d'expertise à distance qui sont entre autres :
  • La téléconsultation, devant permettre à un expert médical de donner une consultation à distance à un patient. Un professionnel de santé (médecin généraliste ou infirmier) peut assister l'expert médical au cours de sa téléconsultation,
  • La télé-expertise, devant permettre à un professionnel de santé de solliciter à distance l'avis d'un ou de plusieurs experts médicaux en raison de leurs formations ou de leurs compétences particulières, sur la base des informations médicales liées à la prise en charge d'un patient.

3.3   Architecture des systèmes d'information

L'implémentation des systèmes intégrés doit conduire à la gestion intégrée de tous les flux d'informations au sein de la structure de soins, l'utilisation de l'outil d'analyse des activités de soins et de gestion de la structure ainsi que l'outil d'extraction et de production de données agrégées pour le SNIS. Les objectifs visés sont [10] :

— Organiser la gestion du dossier patient unique permettant un suivi holistique et longitudinal des malades ;
— Gérer les finances de l'institution ;
— Gérer les ressources humaines et matérielles ;
— Produire les statistiques et rapports sur base de données de routine.

Besoins métiers servis.

Les besoins métiers servis sont l'identification unique du patient, la gestion du dossier administratif du patient, la gestion du dossier financier du patient (tarification, facturation, paiements), la gestion du dossier médical du patient, la gestion du dossier infirmier du patient, la gestion du dossier paramédical du patient, la gestion de la pharmacie, la gestion du laboratoire, la gestion de l'imagerie médicale, la gestion des ressources humaines, la gestion de la comptabilité générale et analytique et l'organisation des soins (agenda, planification). Une telle application devra avoir des interactions avec d'autres pour permettre :

— l'extraction des données agrégées et envoi au SNIS (et/ou autres entrepôts de données) ;
— l'échange de données de ressources humaines avec l'application centrale de gestion de ressources humaines
— l'échange de données avec le système central de gestion des stocks et de la distribution pharmaceutique ;
— l'intégration avec le système central de contrôle de qualité laboratoire ;
— la communication avec les bases de données des ordres professionnels (validation des qualifications des professionnels de santé) ;
— l'intégration avec un PACS régional ;
— l'intégration avec le système de pharmacovigilance ;
— l'intégration de module de téléconsultation et télé expertise ;
— l'intégration avec le système de gestion de l'assurance maladie

3.4   Architecture technologique

Sur base de l'analyse de l'existant, les SIH qui seront déployés sur des serveurs hébergés localement dans les structures de soins devraient s'orienter sur les normes technologiques suivantes :

Interface utilisateur	web (de préférence) ou interface graphique propriétaire (dans le cas d'une configuration client-serveur), mobile.
Outils clients	navigateur web, de préférence l'application sera compatible avec les dernières versions de Chrome, Firefox, Internet Explorer, Opera, Safari. Applications bureautiques standards pour la visualisation et l'analyse de données. Application C++, C# ou .NET pour les configurations client-serveur
Protocoles de communication réseau	http, https
Base de données	relationnelle avec interface ip. L'application est de préférence indépendante du SGBD utilisé.
Système d'exploitation serveur	Linux ou Microsoft Windows
Système d'exploitation client	Linux, Microsoft Windows, Android ou OSX.
Interfaces et API	SOAP, RESTful, HL-7, DICOM, DXF2
Standards d'information	CIM-10, CISP-2, ATC, code-barres, LOINC
Développement	PHP ou Java, JavaScript (éventuellement C++, C# ou .NET pour les configurations client-serveur)

3.5   Analyse des opportunités, défis et solutions

Une étude préalable a permis d'identifier au moins cinq solutions SIH suivantes méritant une capitalisation dans le futur :

7. Le Programme du Parcours Hospitalier ou PPH à l'hôpital de Monkole, développement en VB sur Microsoft SQL Server couvrant une grande partie des fonctionnalités clés du SIH pertinentes en RD Congo ;
8. L'application OpenClinic GA installée aux Cliniques Universitaires de Kinshasa, de Kisangani, de Lubumbashi et à l'hôpital Provincial de Bukavu. Ce logiciel libre et open source développé en Java

utilise une base de données MySQL et intègre un très grand nombre de fonctionnalités dont seulement une fraction a été mise en production dans ces hôpitaux universitaires de la RD Congo ;

9. Le logiciel BHIMA développé par l'organisation IMA World Health et installé en version pilote à l'HGR de Tshikaji au Kasaï Occidental. Il s'agit d'une application dérivée de Bika HIS développée en Python sur une base de données MySQL. A l'heure actuelle, le logiciel se trouve encore dans un stade de développement précoce ;

10. Le SIH OpenERP-Medical, extension de l'ERP générique OpenERP, développé en Python sur une base de données PostgreSQL. La solution n'est pas libre ou open source et offre les fonctionnalités de base SIH avec une forte orientation sur les aspects de gestion hospitalière ;

11. La solution Gestion Hospitalière du développeur Lojiciel à l'hôpital de Kisantu est un développement en VB avec Microsoft SQL Server comme base de données. Le système a été implémenté à travers la quasi-totalité des services de l'hôpital.

Ces solutions seront capitalisées et les études de faisabilité devront être menées pour voir dans quelle mesure elles peuvent être répliquées dans d'autres structures hospitalières.

3.6   Migration et planification

Une migration de l'architecture de départ vers l'architecture cible devra être minutieusement planifiée, l'objectif étant de trier les différents projets de mise en œuvre dans l'ordre de priorité. Les activités comprennent l'évaluation des dépendances, des coûts et des avantages des différentes étapes de migration. La liste des projets prioritaires constituera la base d'un plan de mise en œuvre détaillé ainsi que d'un plan de migration. Il s'agira de répondre préalablement aux questions suivantes avant de se lancer dans cet exercice de migration [10] :

— Quelles sont les implications d'un projet sur d'autres projets et activités ?
— Quelles sont les dépendances entre un projet et d'autres projets ?
— Quels sont les produits nécessaires pour la mise en œuvre du projet ?
— Quelles sont les composantes qui doivent être développées ?
— Est-ce que l'organisation nécessite des ressources complémentaires pour le développement des nouveaux composants ?
— Sur base de quelles normes sont intégrés les produits ou composants et quand seront-ils disponibles ?
— Les produits seront-ils à l'épreuve du temps, à la fois en raison de la technologie qu'ils utilisent que par rapport à la viabilité du fournisseur ?
— Quel est le coût de la conversion des utilisateurs ?
— Quel est l'impact culturel probable sur la communauté des utilisateurs et comment peut-il être contrôlé ?
— Quel est le coût total de la migration et quels avantages va-t-elle livrer ? Il est important d'examiner les avantages réels et ne pas simplement présumer ces avantages.
— Le financement est-il disponible ?
— La migration est-elle viable ?

3.7   Implémentation et gouvernance

Pour garantir une implémentation correcte et pérenne du déploiement national, le développement d'un plan d'implémentation et de gouvernance s'avère indispensable. Les objectifs de ce plan seront les suivants:

— Formuler des recommandations pour le projet de mise en oeuvre
— Construire un contrat d'architecture qui régira l'ensemble des processus de mise en oeuvre et le déploiement sous forme de procédures écrites et signées par toutes les parties prenantes
— Systématiquement exécuter des fonctions de gouvernance appropriées au fur et à mesure que le système est mis en œuvre et déployé
— Assurer la conformité du projet de mise en œuvre avec l'architecture définie.

C'est ici que toutes les informations pour une gestion réussie du projet de mise en œuvre sont réunies. Cette phase établit la connexion entre l'architecture et l'organisation de la mise en œuvre par le biais du contrat d'architecture. Dans ces contrats, les détails des différents (sous) projets seront documentés, couvrant:

— Nom, description et objectifs du sous-projet
— Champ d'application, les produits livrables et les contraintes
— Mesures d'efficacité et de réussite
— Critères d'acceptation
— Risques et enjeux

La gouvernance de la mise en œuvre est étroitement liée à la gouvernance globale de l'architecture. Assurer le respect de l'architecture définie, non seulement par le projet de mise en œuvre, mais aussi par d'autres projets en cours est un aspect clef de la phase d'implémentation et de gouvernance. Au moins dans les premières années du déploiement des systèmes intégrés pour la gestion d'informations des structures de santé, l'assistance des producteurs des solutions choisies apparaît nécessaire. Il est évident que le MSP devra en même temps se doter d'une solide expertise en matière de gestion de projets complexes dans le domaine du développement d'applications informatiques de santé.

4 Discussion

Cette étude nous a permis de démontrer que la mise en place des systèmes intégrés pour la gestion d'informations des structures de soins est non seulement possible, mais aussi indispensable pour arriver à la rationalisation du fonctionnement de ces structures [5]. En effet, les technologies existent aussi bien dans le pays qu'en dehors [10]. La compréhension de comment les TIC peuvent créer de la « valeur » dans les systèmes de santé, on peut prendre de meilleures décisions sur les initiatives en cours et futures dans ce domaine, mieux justifier les nouveaux investissements et mettre en lumière les facteurs de résultats [5]. Le début nécessite un investissement important, mais dans la suite cela permet de rendre efficient le fonctionnement des services de santé [5].

Remerciements

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Design of mobile appointment reminder and counselling system

Theresa O. Omodunbi [1*], Rhoda N. Ikono[1], Ishaya P. Gambo[1], Abisola Oyekunle[1], Hetite A Soriyan[1]

[1]Department of Computer Science and Engineering, Obafemi Awolowo University, Ile-Ife, Nigeria

Background: Most people especially in developing countries only go to hospitals when they are seriously ill. Once they receive treatment and their health condition has improved, they usually fail to go for clinical check-up. This often result in untimely death that could have been averted. We use Nigeria as case study where 90% of adults use mobile telephones believing that educative mobile applications will be of great use to Nigerians. This research investigates the reasons why patients fail to attend clinical check-ups without the medical clearance. A solution is proffered which designed a mobile application that remind patients of clinic appointment. The solution also provide an educational platform on the dangers of not attending clinical appointment.

Methods: In this research, we investigated the reason for patients' absence in consequent clinical appointments using survey method. Structured questionnaire was used to elicit information from patients in general. The patients visiting for the first time were then removed since target was those on scheduled appointment. Those who agreed to participate in the research were then interviewed to get in-depth responses. The Medical Doctors were also interviewed using a questionnaire guide to collect information on clinical appointment absentees'. A model was designed, using Uniform Modelling language, and implement on mobile phone using java programming language.

Results: An educative mobile appointment reminder system was designed and implemented on a mobile telephone. The result from the information elicited from the patients and medical practitioners was used to design the system. The system alerted the patient of the next scheduled clinical appointment and provides information on the danger of not going for the scheduled appointment. A system prototype is presented in this study. It is believed that the attendance will improve.

Conclusions:A mobile appointment reminder and counselling system was developed for low cost affordable mobile phones for low income earners. It has the capability to improve scheduled clinical appointment attendance although only those who forgot the scheduled date will likely be affected by the reminder. Other patients who are disillusioned as a result of long waiting hours may not be affected.

1 Background

Hospital is a place where people who have health challenges go for investigations and treatment [1]. The purpose of setting up a hospital is to give better health service to the people in the community as they visit the hospital with complaints and other physical challenges. Patients go to see medical practitioners of all categories nurse, doctor and/or and other para-medical personnel for check-up, health education.

Medical appointment can be simply defined as an arrangement by medical practitioner(s) to meet a patient at a specific time for health consultation [2]. Patient scheduled for appointment is booked against the next clinic for re-examination and/or feedback. Patients are given appointment in the hospital (out-patient clinic) for check-up, treatment, prevention and management of diseases with the outcome of improved state of health condition. For patients visiting the hospital for the first time for consultation, such is registered and directed to the appropriate clinic. The number of patients a consultant can see in clinic is 22 per day [3]. With the ratio of 1:3500 doctor to patients in Nigeria [4] as oppose 1:600 of WHO standard, more patients are attended to in the clinic. Thus waiting time is often prolonged, in some cases patients are unable to see any doctor. Most of these category of patients are frustrated and discouraged.

First time Patients who have been attended to by medical practitioners are scheduled for appointments. This is recorded in the patient hospital card indicating the date, time, clinic/unit and consultant in charge while the name of the patient is documented in the booking/appointment sheet at the Medical Records'

Unit of the hospital. This method allows a manual monitoring system of the expected patient per clinic per medical doctor.

Once patients' face the ordeal of long queues and waiting time, they usually do not return for the next appointments. Result from this research showed that the stress in waiting to see medical personnel at the clinics far outweigh the visit for patients who are not in very bad health condition. According to the result, they would rather go to 'elewe omo' (African Traditional Medical Practitioners), consult medical practitioners like nurses at home and purchase drugs from chemists and spend the time on other profitable activities not minding the health hazard it poses. A number of the scheduled patients do not even remember the next appointments either because of their ordeal at the first visit, or sometimes due to an assumed improved health condition due to a presumable absence of the initial symptoms. Sometimes absence from clinics is as a result of other more pressing needs. Patient waiting time in developing country is 120 minutes compared to 60 minutes of the western countries [5]. Although Patients are reminded through the hospital cards but often, they do not remember to check once they are engaged in other rewarding' activities.

The motivation for this research arose from an experience of a patient who has been a fibroid patient for two years. She was faithfully attending the clinic fortnightly though not without challenges of long waiting hours. She was later scheduled to appear every three months when her condition improved. There was a long strike in the hospitals that started on her appointment day. When the hospital eventually opened, it was difficult to know when she could report to the clinic since there was no information either about the closure due to strike nor information about re-opening. Moreso, her condition has improved significantly. Two years after, she was in the clinic complaining of the same episode. Right from the medical record officer's desk, she was rejected since she has defaulted about two years. Patients may have genuine reason to miss their appointment; However, health is wealth, it is when one is healthy that appointments can be missed without rational reason.

Defaulting hospital appointments have a huge impact on the care hospital offers to other patients [6]. Hospital procedure is often terminated on account of missed appointments and this affect in general the state of the total well-being of the citizens. In view of this, there is a need to create an automated patient appointment system that will remind patients of their scheduled appointment and also an educative system that encourages patients to attend scheduled clinic when due.

Patients miss about 20% of scheduled appointments for mental health treatment, almost twice the rate in other medical specialties [7]. Up to 50% of patients who miss appointments drop out of scheduled care. Sometimes such appointments can later rescheduled without adverse consequences. Appointment reminder can be done by sending text messages to the patient [7] or calling the patient but this can be expensive. [8] worked on how to encourage patients to attend clinics for subsequent check-up. They proposed face to face counselling to give information on the importance of follow up after the first visit and encouraged them to attend scheduled appointments. It was discovered that time allotted for patients' appointment in Nigerian hospitals is not sufficient to convey the necessary information during counselling. [9] used question-answer method to convey the importance of taking medication regularly but the process proved unsuccessful because some patients' interview did not respond and the verbal way of asking may not yield honest result.

A medical appointment reminder and counselling system is proposed as alternative. Appointment reminder delivers proactive outbound notifications to remind patients of scheduled appointments, or to make an appointment for an annual or follow-up visit. Reminders can be in form of text messages, email services, phone calls or through an application that works with the calendar of your device.

2 Methods

Questionnaires were distributed to patients in teaching Obafemi Awolowo University Teaching Hospital (OAUTHC). The questionnaire was close ended with 10 questions. This was to ensure additional burden would not be added to respondents (see appendix A) who are already getting inpatient resulting from long waiting time. 100 questionnaires were distributed to outpatients of General Outpatient Department (GOPD) who can read and write and 91 respondents rightly fit the required category of patients. At first questionnaire were administered to all categories of patients but the target respondents were patients who were not visiting for the first time. Summary of the result were given to doctors in the GOPD and on request, they also gave counselling notes that was used to design the mobile application. The system was

implemented on low cost mobile phones that can access internet and run on Android or JAVA Operating Systems.

3   Result and Discussion

3.1   Questionnaire Result

In the analysis, 58 (64%) of the patients covered were female while 33 (36%) were male. This is an indication that most patients are female. Patients covered were averagely educated. 83% of the respondents were educated and 17% were not. Of the total, 7% had post graduate certificate, 26% tertiary (NCE, HND, Bachelors), 26% secondary certificate and 24% primary certificate as shown in figure 1. It can be deduced that since the majority are educated that they are not totally ignorant of the implication of absence from hospital appointments. Figure 2 showed that female are less educated than male patients though they visit hospital more than the male. 75 (89%) out of 84 who had visited the hospital before defaulted in clinic appointment. This figure gave credence to the need to develop a reminder system for patients.
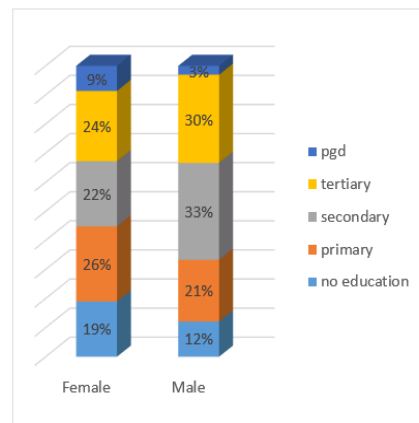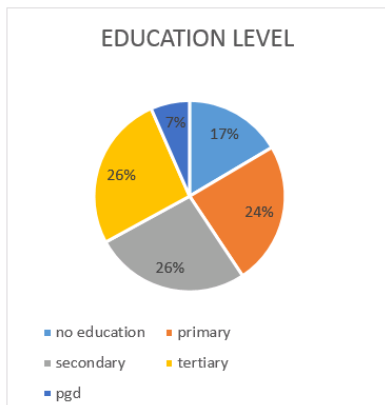

Figure 1. Education level of Patients covered

Figure 2. Gender Distribution with their level of Education
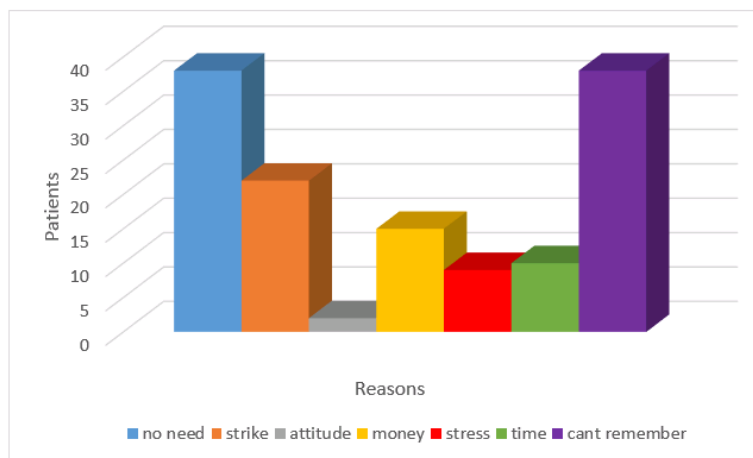
Figure 3. Reasons why Patient miss appointment

The remaining 9 patients who completed their treatment are patients with a minimum of first degree certificate. They are highly educated and they know the implication of not completing medical treatment.

Further questions were asked to know the reason why they defaulted in keeping their appointments. It was discovered that patients fail to show up in subsequent appointment schedule because of three major reasons namely (1) there is no need to attend clinic again, (2) medical personnel strike action (4) forgetting the date of appointment. This is depicted in figure 3. Other reasons are cost that will be spent in the hospital, stress and long waiting time before a doctor can be consulted and unethical attitudes shown by personnel in the hospital. Other reasons mentioned are distance between the hospitals and Patient location/residence as well as strong odour of the hospital environment were also given for absence from Scheduled appointments. It can also be deduced from the results that the problems encountered and the experiences of the patients during visits may be responsible to the failure of completing treatment by not showing up for scheduled appointments at the slighted improvement feeling. From the interview, the respondent were of the opinion that 'there is no need to waste time, money and energy going for check-up or follow up'. This is an indication that the problems faced outweighed the total well-being of the patients. Majority also gave reasons of the industrial strike action by hospital staff without any announcement of closure which often result in the distortion of the appointments days without any effort to reach the patients for rescheduling of the appointments nor send information on the re-opening of hospitals for service provision.

The manual system of keeping appointments details both in the patients' hospital card and at the hospital are also made it easy to miss the scheduled appointments. With the dwindling economy, an average Nigerian will always cut cost as much as possible. Money paid at each appointment, cost of drugs and/or investigations fees are strong indication for absence. When patients default on appointments, they create a challenge for the hospital. The time allotted for the patients should have been allotted to other patients when appointment is missed but the Medical Record officers claimed that usually more patients are scheduled for a particular appointment since a number will not show-up. Every respondent wanted a reminder on their phones if it is free. However, it is not certain that the availability of a 'free' reminder system will directly address all the problems except the problem of forgetfulness and with persistent reminder a few others will yield.

3.2   Model Design

In designing this mobile application, use case diagram of the system is designed to describe the functions that can be carried out in the application by the user. This is depicted in figure 4. Users are patient and they can enter appointment schedule, and set a reminder. The reminder application gives a reminder which is interactive. The reminder asks if the patient is attending and give medical advice concerning the ailment of the patient. Figure 5 depicts the overview of the proposed system. A patient sets up a reminder in the application with the time to alert the patient. The proposed system will alert the user and it will ask the patient if he will be going for clinic. The answer to the question will determine when to display counselling information regarding the clinic of the patient. The counselling module is a knowledge based information system with different topics on diseases. It gives sample cases of the ailments and how it degenerate if care it's not taken. This knowledge is not to scare patients but to make them know that even if their ailments are incurable, it can still be managed with proper care. Also if the ailment is curable, it can lead to death if it is not attended to promptly.

Figure 7 depicts different screen shots of the application. Once an appointment is initiated, there should be no break whatsoever until it is completed. The system tries as much as possible to give information the patient needs to know about his health status and encourages the patient not to miss appointment.

The system is implemented in java with capacity of 3.6MB and it can be installed on any java enabled phone.
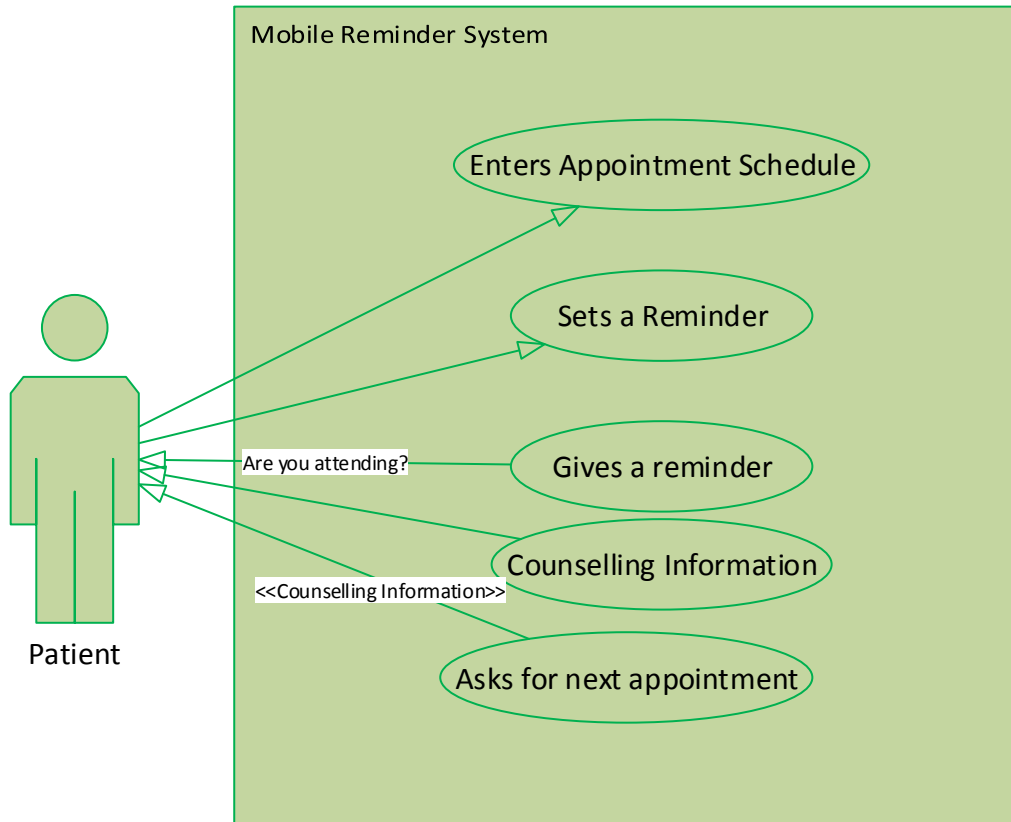
Figure 4. Use case diagram of Mobile appointment
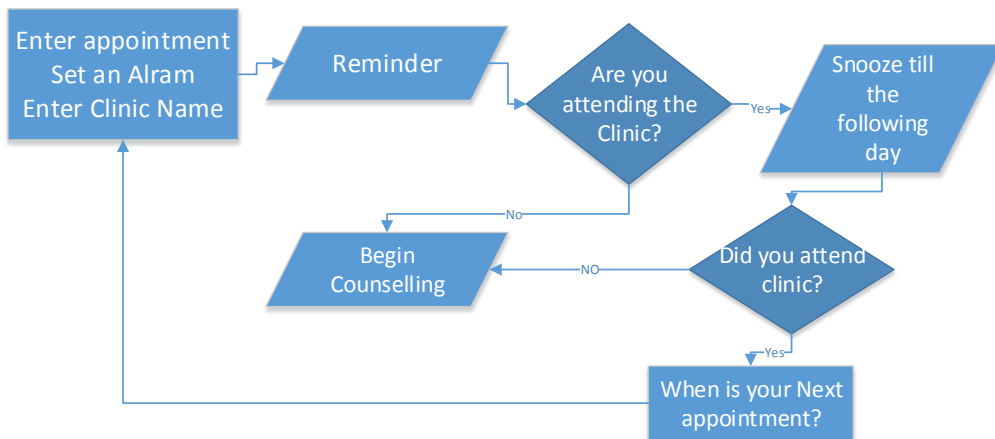
Figure 5. – Overview of the proposed Mobile appointment reminder system

4   Conclusions

The problems of missed scheduled appointments have been established in Nigeria and reasons alluded to it has been highlighted. Some deductions were made from the results which should be addressed. However, this research attempted to solve one of the problems which is 'not remembering the details of

scheduled appointments'. Our response to this is designing and implementing a mobile appointment reminder and counselling application on low cost phones with minimal storage capacity.

The work has been given to some patients for testing and we are yet to evaluate the effect of the system. It is believed this will reduce 'no-show appointments' as people begin to receive alert on their scheduled appointments as well as additional information concerning their health.

This research concluded that though the proffered solution may not address all the highlighted problems of missed hospital appointments, but the system has contributed to the improvement of total well-being of some Nigerians.
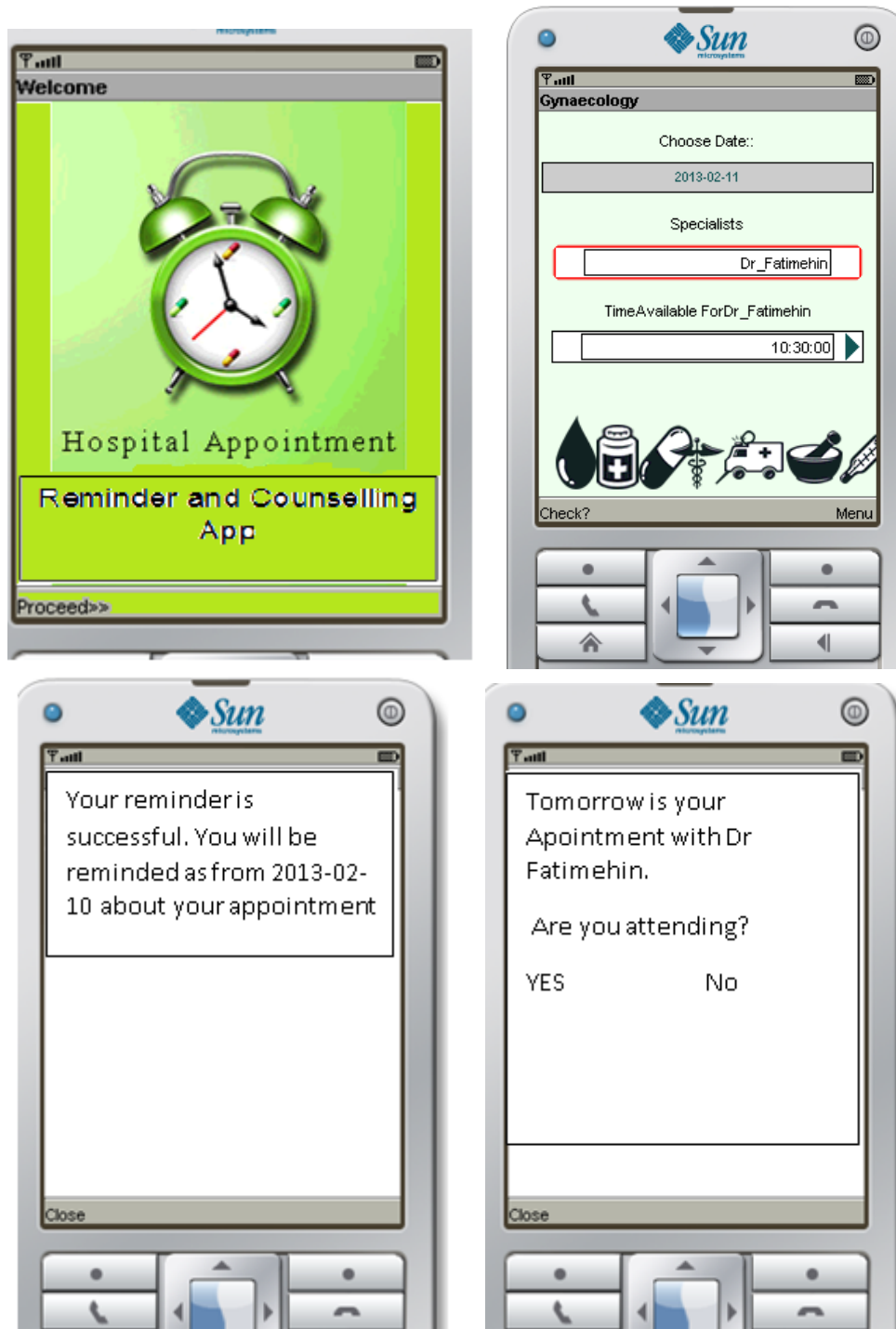
Figure 6. – Screenshot of the Mobile appointment reminder app

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Additional files

Additional file 1 – questionnaire Analysis

Reporting in the health systems: case study of Ghana

Ivy de-Souza

Accra - Ghana

`ivylution@gmail.com`

Marc Nyssen

Brussels – Belgium

`mnyssen@vub.ac.be`

Next to treating patients, the health system has important and most relevant tasks, amongst which: reporting. Reporting not only allows detection of disease outbreaks, it also contributes greatly to enable good management of the health system nationally and internationally, because objective data is required to enable planning, follow-up and management towards improvement. In this paper, we analyse the current operational reporting system in Ghana's health system and on this basis, considering the availability of current ICT tools, propose possible improvements.

Keywords: Ghana Health system, e-health, data management, reporting.

1   Introduction

The World Health Organization's "The World Health Report 2000" [1], emphasises on health reporting systems in order to give a clear overview of the world health statistics. WHO gets its health statistics data from the member countries' Ministries of Health year by year. The Ministries of Health (also in Ghana) collect monthly information throughout their health systems via monthly reporting that converges via the hierarchic national health care structure through districts and regions to finally reach the Ministry, where the National office then summarizes the data from the regions. The core capacity of validating and analysing DHIMS data lies with the Ghana Health Services (GHS) [5].

For long, reporting was paper-based. This is cumbersome, expensive and requires a heavy work-load, the current reporting system in Ghana uses computer software. It is called the District Health Information System (DHIMS2) [3]. Unfortunately DHIMS2 is not yet available at the sub-district level [4].

The purpose of this study is to obtain quantitative and qualitative information on the current reporting practice. The total number health facilities in Ghana are: 3220 [6]. Consisting of: 3 reference hospitals, 9 regional hospitals, 96 district hospitals, 11 polyclinics, 2083 health centers and 1018 hospitals, including the private ones; these are all supposed to produce monthly reports. On the collecting side, we have the 226 health directorates and the Ministry of Health.

2   Materials and Methods

Information for this research was obtained from both primary and secondary sources. Primary data were obtained from field surveys and by interviewing participants using questionnaires while Secondary data were obtained via the Internet, lecture notes, books, thesis and journals by thorough literature searches. Both quantitative and qualitative methods were adopted for this study. Participants were interviewed using questionnaires, specifically aimed at obtaining performance, efficiency and quality data on the reporting system in place. In all, fifty-three (53) participants were interviewed: 50 from both public and

private health facilities and health directorates, spread over the country. Two health information officers, one from the Ministry of Health and one from WHO respectively and an officer from the Traditional and Alternative Medicine Directorate also participated in the interviews.

From the health care institutions, 25 data managers and 25 heads of departments (directors/CEOs) were interviewed. Both males and females participated in the study: 28 males and 25 females were interviewed. All participants are above 20 years and the age group ranges between 25 to 60 years. Measures were taken to ensure that the selected individuals were well versed in the field of the study.

To obtain the information regarding the reporting system, specific questionnaires were designed and validated by two experts in ICT for health.

The questionnaires contained specific questions about:
- time spent in filling in and processing the monthly health care reports
  - by personnel (in FTE's)
  - by ICT manager and by director (in hours/month)
- quantity of reported data
- quality of reported data
- usefulness evaluation by the participants in the reporting system
- feedback

The questionnaires were distributed, then collected "on paper", but for processing, data entry was performed centrally via a specifically configured public software "LimeSurvey". A selection was made to reasonably enable a single researcher to cover the different types of institutions by the sample taken: all 3 reference hospitals, 2 regional hospitals, 3 district hospitals, 3 polyclinics, 3 health centers and 4 hospitals (2 of which private).

On the processing side: 7 directorates and the Ministry of Health were covered.

3   Results

3.1   Quantitative Analysis

By compiling the responses to the question of how many FTE's work on reporting in each type of health care institution, we can make an estimation of the total work-load, currently spent on reporting in the whole country. Per type of institution, we calculate the average (FTE for reporting) and the standard deviation stdev, taking into account the N samples. From these values we then can calculate the 95% certainty interval 2A of the workload in FTE's for each type of institution, by the Equation 1

Type of facility	sample size	FTE	FTE	A	average - A	average +A	B	B * min	B * max
	N	average	stdev	1.96*(stdev) / sqrt(N)	min	max	NUMBER	MIN	MAX
Reference Hospitals	3	61.67	24.44	27.66	34.01	89.33	3	102	268
Regional Hospitals	2	41.50	37.00	51.28	0	92.78	9	0	835
District Hospitals	3	24.33	28.00	31.68	0	56.01	96	0	5377
Polyclinics	3	14	10.15	11.49	2.51	25.49	11	28	280
Health centres	3	9.67	7.77	8.79	.88	18.46	2083	1828	38458
(Private) Hospitals	4	5.75	3.10	3.04	2.71	8.79	1018	2761	8946
TOTAL:	18	29441					3220	4719	54164

Table 1. Number FTE's active in reporting per type of Health facility

The effective interval is then obtained as: (min=average−A, max=average+A).

$$A = 1.95 * stdev / (sqrt N). \qquad (1)$$

The number of FTE's per type of institution will be with 95% certainty can then be calculated by multiplying with the number of institutions. Summing up minima (FTE's) (**MIN**) and maxima in FTE's (**MAX**) gives us an estimation for the whole country. This is shown in Table 1.

The same can be performed for the workload required to process the monthly reports in the health directorates and at the Ministry of Health, as shown in Table 2.

Type of institution	sample size	FTE's	FTE's	A	Average – A	Average +A	B	B * min	B * max
	N	Average	Stdev	1.96*(stdev) / sqrt(N)	Min	Max	NUMBER	MIN	MAX
Ministry of Health	1	2	.00	.00	2	2	1	2	2
Health Directorates	7	48	37	27.41	20.59	75.41	226	4653	17043
TOTAL:	8	**10850**					**227**	**4655**	**17045**

Table 2. Number of FTE's spent in processing monthly reporting

The mean time spent in processing monthly reporting with confidence interval 95% in FTE's (per institution and summed for the whole country).

3.2   Qualitative Analysis

Following aspects were covered in the qualitative part:

- feedback by the system to the reporting institutes: most, 84% of the participants received feedback to their reports and 16% did not
- quality of data: data verification mechanisms
- timeliness
- effort required for standard reporting and for specific reporting of infectious diseases
- evaluation of the reporting system at the MOH
- evaluation of the reporting system at the "traditional and alternative medicine department
- Evaluation of the reporting at the WHO level.

4   Discussion

Although the sample we took from the health system is small (realistic scope for a single researcher in the context of a personal study), the sample represents the whole of the health system: health centres, district hospitals, regional hospitals, polyclinics, private hospitals and reference hospitals. All 3 reference hospitals of the country are included and for the categories: health centres, district hospitals, regional hospitals, polyclinics, private facilities. "In town" and "countryside" institutions are present in the sample, therefore we think that valid conclusions can be taken from this study, although the spread will be quite large due to the rather small sample size. In both pre-test and field survey, participants also agreed it is rather essential to have representative views from most health facility categories within the health system rather than large numbers per few categories since the reporting format for each category or level, especially the government institutions is very similar.

4.1   Discussion of Quantitative Elements

From the results obtained with estimation of 95% certainty total workload for producing reports in a month per institution per type are as follows:

- reference hospitals employ between 102 and 286 FTE's
- regional hospitals between 0 and 835 FTE's
- district hospitals between 0 and 5377 FTE's
- polyclinics between 28 and 280 FTE's
- health centres between 1828 and 38458 FTE's
- (private hospitals) are between 2761 and 8946 FTE's.

Also with 95% certainty the workload in the whole health system is situated between 4719 FTE's and 54164 FTE's with an average of 29441 FTE's. Taking into account the workload for reporting on directors and managers of these institutions, we can add about 800FTE's to these numbers. The number of full-time equivalents for processing monthly reporting in the Ghana Health System is estimated at 10850, with a 95% confidence interval between 4655 FTE's and 17045 FTE's. These huge workforces, involved in monthly reporting are employed in the health system, but do not directly contribute to the care of the patient!

4.2   Discussion of Qualitative Elements

Feedback.
A total of 84 % of respondents received feedback to their reports. Comparing responses from the various categories of health institutions interviewed, the private and reference hospitals receive more feedback then the government facilities. Thus internal feedback is regular than external feedback. For those who received feedback the numbers vary between 1 – 12 feedbacks in the last 12 months. Several uses of feedback are mentioned:

    i.   Making necessary correction

    ii.   Note important issues raised

    iii. Archiving

    iv. Paste on notice board for data collectors views

    v.   Improve upon performance where necessary

    vi. Send back to various facilities.

    i.   Follow up / contact tracing

    ii.   Factor into policy actions

Ministry of Health (MoH).
The Ministry of Health analyses all monthly data submitted by health facilities using statistical means. Feedbacks are given to respective agencies. The feedbacks are sent as reports, both in electronic and hard-copy formats. The feedbacks on performance indicators are sent quarterly and yearly. Codes, passwords and authorized users are security systems used to protect the data. Districts league table, reward systems and sanctions at facility levels are measures taken by the Ministry towards late reporting by health institutions. The Ministry takes policy actions such as Monitoring and Evaluation Framework, Data Repository Framework as a result of data collected from the Health facilities as well as campaigns. The Ministry also reports to international bodies such as WHO and GLOBAL FUND.

Traditional and Alternative Medicine Department.
According to the officer interviewed, the Traditional Medicine Practice Council was formed by the government to oversee their activities especially those at the private sector. It also controls practices and registration of professionals and facilities. The officer explained that not all practitioners are registered.18 Herbal Medicine Centers have been set up in selected government hospitals and health facilities at least one in each region in the country. Service delivery by the medical herbalist is supervised by a physician

and activities of the herbal medical practices are included in the facility and hospital reporting to the Ghana Health Service and Ministry of Health [8].

World Health Organization (WHO).
Reporting to WHO is not regular. It is generally weak, less quality and less reliability. There is no good system, most data are not classified according to ICD coding.

Although the internal reporting system seems to work, according to our respondents, Ghana 's cause of death information is still reported to WHO with long delays. An interview with a WHO official revealed that the country level reporting towards WHO is far from ideal.

Some reports on immunization are received by WHO and UNICEF but sometimes with 5 months to several years delay. There are also some reports on MDGs to WHO and UNICEF on population. To obtain relevant information, WHO itself has to employ people to do the job. WHO publishes the acquired estimates via the Global Health Observatory (GHO). Data verification by WHO is done via registers [7]. Types of Data verification include:

12. House-hold servers
13. Internal facility servers
14. Administrative servers
15. Birth and death among others.

There are no electronic formats.

Countries with alarming indicators or epidemics are double-checked but reporting on epidemics is mostly political especially if it has to do with tourism, etc. Currently, WHO does not obtain "cause of death" data from Ghana. The major challenges according to the officer interviewed are that much is not done on reporting to WHO and there are problems regarding quality and timeliness of reported data.

5   Conclusions and Recommendations

This study identified that Ghana has fairly strong health information system but cause of death information – from hospitals and from communities is still weak. The DHIM2 software is the tool used for data collection and all routine health services. However it requires "human intervention" and moreover it is not fully used by all health facilities in the country. Other HIMS are used in some facilities. Some private facilities report to the Ministry of Health and others do not.

Service deliveries by the medical herbalists are supervised by physicians and activities of the herbal medical practices are included in facility and hospital reporting to the Ghana Health Service and Ministry of Health.

The work-load associated with reporting is huge. With respect to data collection, reporting and data compilation. 52% of the participants estimate that the workload for reporting is too much, others say the workload is very stressful and extremely cumbersome. The following recommendations are made for consideration:

- it is necessary to get a unified reporting system and policy on reporting format for both private and government health facilities in the country;
- the number of reporting forms used should be reduced or merged;
- there should be regular training for health information officers;
- DHIMS2 should be reviewed and if possible modified to reduce the need for human intervention, by linking to electronic medical records and e-Health applications for example OpenClinic, so that human resources can be involved in updating the patient records (to the immediate benefit of the quality of care), with periodic report generation and transmission to the authorities in a standard format as a side effect, requiring just a single click.
- It is also recommended that there should be regular feedback to all reports. According to participants most feedbacks are on National Health Insurance claims. Other feedbacks are received only at quarterly or annual review meetings. There is little or no feedback for on referral and other activities reported cases even though this would help measure progress and motivate improvement.

Acknowledgments.

Thanks to all who collaborated and responded by carefully filling in their questionnaires and taking time for the interviews.

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A survey of the barriers to interoperability of Nigeria healthcare systems

Ikono Rhoda[a,*], Soriyan Abimbola[a], Iroju Olaronke[b], and Gambo Ishaya[a]

[a] Department of Computer Science and Engineering, Obafemi Awolowo University, Ile-Ife, Nigeria
[b] Department of Computer Science, Adeyemi College of Education, Ondo, Nigeria

Background and Purpose: Globally, interoperability is very essential in healthcare systems. This is because it enhances the easy access to patients' information during care, it reduces medical errors and healthcare cost, it facilitates the interactions amongst healthcare providers globally and it also facilitates the integration of health related information. Thus, interoperability in healthcare creates better health for individuals, communities, nations as well as the world at large. However, most healthcare systems and organizations around the globe are not interoperable. This explains the decreased quality in healthcare and the increase in mortality rate across the globe. Consequently, this study examines the barriers hindering interoperability of healthcare systems using Nigeria as a case study.

Methods: The study employed an extensive literature research as well as the survey method to obtain a holistic and an in-depth investigation of the study.

Results: The results of the investigation revealed that reluctance of healthcare practitioners to change from the use of traditional paper based system to electronic health systems, lack of a unified healthcare standard, corruption, inadequate power supply, lack of a unified terminological set in healthcare, poor maintenance culture, privacy and security concerns, proliferation of incompatible electronic health systems as well as the lack of trust among stakeholders in the circle of care are some of the factors hindering interoperability of healthcare systems.

Keywords: interoperability, electronic healthcare system, Nigeria healthcare system

1   Introduction

Globally, the major business process of the healthcare system is to manage patients' information either manually or electronically. However, in recent times, most healthcare systems are designed and implemented to take full advantage of Information and Communication Technologies (ICTs) tools to efficiently and effectively acquire, store, process, retrieve and utilize patients' information for effective healthcare delivery. Nevertheless, patients' can have numerous health related episodes over a period of time which might involve multiple healthcare professionals. These health episodes may be presented in diverse geographical locations and systems due to patient relocation, readmission and multiple treatments. This causes patients information to be spread across divergent systems in different proprietary formats. This leads to fragmented and heterogeneous data resources and services which contribute to the emergence of islands of information [1]. However, there is a need for healthcare practitioners to interact and access patient information in these systems in a consistent, reliable and transparent way, anywhere and anytime, as required by the treatment path of the patients [2]. Nonetheless, the interaction as well as the seamless exchange of patients' information across healthcare systems at the point of care is usually formidable as a result of the heterogeneity in the systems, data and data format [3]. This heterogeneity represents a major problem in data exchange among healthcare systems. This results in severe interoperability problems [4]. As a result, most healthcare systems around the globe are fraught with high cost, high error rate as well as decreased quality of healthcare. Consequently, interoperability of healthcare systems is a global issue because no country can maintain a steady economic growth in the

absence of an adequate healthcare system. Thus, the wealth of a nation is dependent on the health of its people.

Efforts have been made by countries such as the United States of America to achieve seamless exchange of information amongst healthcare systems and healthcare practitioners to no avail [5]. Furthermore, the Nigerian healthcare policy makers, healthcare practitioners and patients have not been able to address the problem of lack of interoperability among healthcare stakeholders during care. Consequently, the healthcare delivery system in Nigeria is characterized by increased cost and increased inaccessibility to healthcare and thus a high rate of mortality [6]. The World Health Organization ranked Nigeria 187 out of 191 countries in health system performance [7, 8]. Consequently, this study explores the factors hampering the seamless exchange of patients' information amongst healthcare systems and practitioners in Nigerian healthcare system.

2   Research methods

The study employed literature search in order to have an in-depth understanding of the concept of interoperability and its importance to healthcare. The aim of the literature review was basically to build a basis for the study. A well designed and structured questionnaire, qualitative and quantitative in nature was used for data collection. This was to ensure that an appreciable result was obtained from the research. The questionnaire was designed to be comprehensive, easy and fast to complete. The questions in the questionnaire were basically derived from the reviewed literatures on interoperability of healthcare systems. The questionnaire contained both open and close ended questions in order to obtain a holistic and an in-depth investigation of the study and also to ensure that an appreciable result was obtained from the research. The questionnaires were administered to various healthcare professionals in the Nigeria healthcare system. The data collected was analyzed using Microsoft Excel.

2.1   Study location

The study was conducted in South Western Nigeria. Five tertiary healthcare systems including three teaching hospitals were used. These includes: Obafemi Awolowo University Teaching Hospital, Ile-Ife, Osun state, University College Hospital Ibadan, Oyo state, and University of Lagos Teaching Hospital, Lagos, Lagos state. Two Federal Medical Centres at Owo in Ondo state, and, Ido Ekiti, Ekiti state respectively were used. Three secondary healthcare facilities which include General hospitals at Adeoyo, Ibadan, Oyo state, Ondo state and Oke ogbon healthcare centre, in Ile-Ife were used for the investigation. Two primary healthcare facilities which includes Enuwa primary healthcare centre, Ile-Ife, and Alegongo primary healthcare centre in Ibadan were also used for the study. Furthermore, nine private hospitals which includes Poly Clinic and Maternity, Ibadan, Alafia Hospital, Ibadan, Amen Hospital, Sango, Ibadan, Kings Hospital and Maternity Centre, Ibadan, Chrisbo Clinic and Maternity, Ibadan, O-Physio clinic Ibadan, Adebare Specialist hospital, Ile-Ife, City Hospital and Maternity care, Lagos and Talent Specialist hospital, Ipaja, Lagos were used. In addition, one missionary hospital, Seventh Day Adventist Hospital, Ile-Ife was also used for the study.

2.2   Study population

A total of 20 questionnaires were administered in each of the 5 tertiary healthcare systems as well the 3 secondary healthcare systems. This accounted for a total of 100 administered questionnaires in the tertiary healthcare system and 60 in secondary healthcare system. Five questionnaires were administered to healthcare workers in each of the primary healthcare systems, and ten questionnaires were administered in each of the nine private hospitals as well as the missionary hospital. This accounted for fifteen questionnaires in the primary healthcare system and 100 respondents in the private and missionary hospitals. Hence, the study population consisted of a total of two hundred and seventy respondents. The study population consisted of 80 physicians, 115 nurses, 30 radiologists, 25 pharmacists, 20 laboratory technologists. These individuals were purposely selected based on their knowledge and experience regarding interoperability in healthcare.

3 Data Analysis and Discussion

3.1 Demographic Information

This section presents and analyses the results obtained from the questionnaire. Our findings revealed that 48.89% of the respondents were males while 51.11% of the respondents were females. 66.67% of the respondents were married while 26.67% were single, and 6.67% were divorced. The result also shows the distribution of the respondents by religion which states that the majority of the respondents are Christians representing a total of 78.52%, while 21.48% of the total respondents were Muslims. It is also understood that the educational qualification of the respondents is high. The result shows that large populations of the respondents were degree holders representing 50.00% of the total respondents while 29.63% of the total respondents were master's degree holders and 20.37% had other qualifications such as Registered Nursing certificate.

Table 1 shows the factors affecting interoperability in Nigerian healthcare system. A total of 100% of the respondents reported that epileptic/erratic power supply adversely affects interoperability in Nigeria healthcare system. This is because many rural areas lack electricity supply whilst in the towns and cities where there is limited electricity. Therefore, the generation and distribution of electricity in Nigeria, negatively affect the diffusion levels of ICT adoption (Akpan-Obong, 2007). Thus, electricity is a major factor hampering the development and diffusion of ICT in Nigeria healthcare system. 89% of the respondents identified that inadequate electronic healthcare system was a major barrier to achieving interoperability in Nigeria healthcare system, while a total of 65% indicated that the adequate technical knowhow/skills needed to operate these electronic healthcare systems affects the seamless exchange of information amongst healthcare providers. 75% of the respondents reported that healthcare practitioners are reluctant to change from paper based system to ICT based systems. The investigation also revealed that 57% of the respondents indicated that lack of trust amongst healthcare practitioners is a barrier to the seamless exchange of information amongst healthcare practitioners. The study also showed that 85% of the respondents agreed that security threats and privacy are major impediments to interoperability of healthcare system. 76% of the respondents agreed that the lack of standards/unified healthcare terminology affects the flow of information amongst healthcare practitioners while 96% of the respondents specified that poor maintenance of the limited ICT facilities affects interoperability of healthcare systems. Thus, the state of infrastructures, especially telecommunications infrastructure poses a major hindrance to interoperability in Nigeria. 80% and 88% of the respondents believed that corruption and political instability affect interoperability of healthcare systems. 100% of the respondents believed that the proliferation of incompatible electronic health systems is a major impediment to the interoperability of healthcare systems while 90% of the respondents agreed that the lack of a legislative framework that supports e-health affects the seamless exchange of information in healthcare systems.

The global literature view of interoperability in healthcare requires constant power supply, seamless exchange of data and/or information within and across various healthcare facilities, but within the context of this study, this is not so. Hence, there is a need for data sharing and re-use among healthcare applications and devices, which will in turn reduce healthcare cost and improve the quality of care.

Table 1. Factors Affecting Interoperability in Nigeria Healthcare Systems

Serial Number	Factors	% of Respondents that Agree that the Factor is a Barrier to Interoperability in Healthcare
1	Epileptic Power Supply/ Electricity constraints	100%
2	Inadequate electronic healthcare systems	89%
3	Lack of adequate skills to operate electronic healthcare systems	65%
4	Reluctance of healthcare practitioners to change from paper based system to ICT based systems	75%
5	Lack of Trust amongst healthcare practitioners	57%
6	Security and Privacy Issues	85%
7	Lack of standards/unified healthcare terminology	76%
8	Poor maintenance of the limited ICT facilities	96%

	provided	
10	Corruption	80%
11	Political instability	88%
12	proliferation of incompatible electronic health systems	100%
13	lack of a legislative framework that supports e-health	90%

4   Conclusion

This study investigated the barriers to interoperability in Nigeria healthcare systems. The study employed the questionnaire survey method to obtain information on the factors hindering the effective flow of information amongst healthcare practitioners in Nigeria. The survey method was achieved via the use of a total of two hundred and seventy questionnaires which were distributed to various healthcare practitioners in the Nigerian healthcare system. The study revealed that epileptic power supply, inadequate electronic healthcare systems, lack of adequate skills to operate electronic healthcare systems, lack of trust amongst healthcare practitioners, lack of standards/unified healthcare terminology, political instability, proliferation of incompatible electronic health systems and the lack of a legislative framework that supports e-health are some of the hindrances to interoperability amongst healthcare practitioners in Nigeria.

Therefore there is a need for proper management of information, dissemination and the interoperability needs from all the different sources of information within healthcare system. Also, Nigerian decision makers in government institutions should take into cognizance the promotion of ICT innovative products, solutions and services in healthcare system. Equally assist to promote healthcare services within the framework of National health policy.

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eHealth strategy situation assessment in Malawi

Maganizo Monawe [a,*], Shawo Mwakilama [b], Gibson Kapokosa [c]

[a] I-TECH Malawi and Ministry of Health, Lilongwe, Malawi
[b] Baobab Health Trust, Lilongwe, Malawi
[c] Ministry of Health, Lilongwe, Malawi

Background and Objectives: To facilitate the development of eHealth Strategy for Malawi, the Ministry of Health initiated the eHealth Strategy Situation Assessment. The aim of the assessment was to enlighten the framing of the eHealth Strategy through systematic review of existing infrastructure, the challenges that hinder health service delivery and gaps that need to be addressed.

Methods: The assessment process consisted development of a research protocol, data collection, data analysis and reporting. The first phase was a comprehensive literature review to identify the main issues to be included in the assessment. The second phase was a survey where three questionnaires were administered. The focus of the issues in the questionnaires included information for decision making, health worker to patient ratio, drug logistics, adherence to clinical guidelines, health surveillance, patient follow-ups and monitoring, monitoring and evaluation, ICT infrastructure, human resources, training and e-governance. A gap analysis was performed to reveal the areas that require strengthening in order to realise success in application of ICT in the health sector in Malawi.

Results: The assessment found that healthcare workers have challenges in making decisions since most data are available in manual formats making them difficult to process and share. Additionally, it was found that facilities face challenges in ehealth human resources development, managing access to data, performing disease diagnostics and managing stocks, among others. Additionally, it was found that a number of ehealth solutions have been deployed in facilities although most remain at pilot stage and face low utilization due to challenges such as lack of connectivity, lack of basic computer hardware, high workload of healthcare workers, among others. Respondents expressed optimism that replacing the manual records management with ehealth solutions can improve health service delivery by bringing in efficiency and reducing workloads.

Conclusions and Recommendations: The assessment recognizes manual management of data and lack of policy frameworks as key areas that need strengthening. It is therefore recommended that the Malawi national ehealth strategy should focus on addressing issues of manual management of health service delivery data, poor ICT infrastructure, inadequate and unreliable power supply, lack of integration and interoperability of systems, lack of adequate ehealth governance and policy instruments, among others.

Keywords: Assessment, eHealth Strategy, Electronic Health, Malawi

1 Introduction

1.1 Background and Purpose

At global level a number of resolutions support the integration of ICT in health service delivery. Ehealth strategy is a tool to achieve Universal Health Coverage (UHC) which has been set as a possible umbrella goal for health beyond 2015 development agenda. UHC is the goal that all people obtain the health services they need without risking financial hardship (16) and it requires strengthening the delivery of health services in five main areas: Health systems financing; health workforce; essential medicines and health technologies; health information and resources, governance; and health systems service delivery. WHO report highlights that ICT is important input to achieve the UHC goals as highlighted by a number of World Health Assembly (WHA) resolutions which require its member states to integrate ICTs in health service delivery as follows: Resolution WHA58.28 of 2005 set the direction and encouraged countries to

have eHealth strategies; Resolution WHA66.26 of 2013 focused on national standards, strategies and Internet for health; and World Telecommunications Development Conference Resolution WTDC-65 of 2010 calls for development of national ehealth strategies. As a signatory of the above three resolutions as well as the UN Commission on Information and Accountability (COIA) for Women's and Children's Health which calls for global reporting, oversight and accountability for women's and children's health, Malawi is committed to implement those resolutions. Additionally, the Malawi Health Sector Strategic Plan (HSSP) necessitates the development of an ehealth strategy in order to support the delivery of its outcomes through improving access to health services, improving care, and strengthening monitoring and evaluation. The ehealth situation assessment was therefore conducted to ensure that the strategy to be developed is able to respond directly to these issues.

1.2   eHealth Strategy Concepts

The conceptual reflection of ehealth strategies starts with understanding what ehealth is. The World Health Organization (WHO) defines e-Health as the use of Information and Communication Technologies (ICT) for health (14) where emphasis is put on improving the flow of information, through electronic means, to support the delivery of health services and the management of health systems. Similarly, the Department of Health in South Africa has defined e-Health as: the combined utilization of electronic communication and information technology to generate, transmit, store and retrieve digital data for clinical, educational and administrative purposes (7). These two definitions stress on using electronic means to manage health data. Furthermore, Eysenbach (5) extends the definition e-health by bringing in the concept of medical informatics which essentially asserts that a health worker can be more effective when supported by ICT than when working alone. On one hand, the World Health Organization (WHO) and the International Telecommunication Union (ITU) released in 2012 an e-health strategy development toolkit (15) which recognizes three main components of an e-health strategy namely e-health vision, e-health action plan, and e-health monitoring and evaluation. On the other hand, Scott and Mars (12) identify four primary components of e-Health as follows: i. health informatics (collection, analysis, and distribution of health related data; e.g., electronic records, surveillance), ii. Telehealth (direct or indirect interaction with other health care providers, ill patients, or well citizens, e.g., teleconsultation; social networking), iii. e-learning (use of ICT to provide teaching and education opportunities to health care providers and citizens), and iv. E-commerce (related to the business side of health care, e.g., electronic reimbursement). Further classifications are available through country specific ehealth strategies with notable variations on focus areas due to differences in national contexts.

2   Materials and methods

In order to assess the status of e-health in Malawi a task force was formed comprising members from the Ministry of Health, Baobab Health Trust, Centers for Disease Control and Prevention, and the department of e-Governance. The first part of the assessment was a desk review which examined a number of literature sources in order to identify the main issues that are supposed to be included in an e-health strategy. At national level, a number of documents were reviewed including the Malawi Health Sector Strategic Plan for 2011 – 2016, the National ICT Policy (4), the draft HIS strategy, the MoH Handbook of indicators (9) and the 2009 HMN Health Information Systems Assessment Report (8). Existing data collection and reporting tools were also reviewed. At international level, the WHO/ITU e-health strategy development toolkit and e-health strategy documents for South Africa, Scotland, Australia and Slovenia were reviewed, among other literature. The second part of the assessment was a qualitative survey where data was collected using questionnaires. The questionnaires were administered by enumerators to clinical and management staff of select health facilities across all health zones in Malawi. These facilities were selected based on their levels in the health service delivery structure which are primary, secondary and tertiary facilities. They were further classified as government, private and mission hospitals. Based on these classifications fourteen government facilities, three mission facilities and four private facilities were purposively selected for assessment. Of the government facilities three were primary, seven were secondary and four were tertiary facilities. Since this was mostly qualitative assessment, qualitative data analysis was done with the help of Nvivo software. The questionnaire responses were input into the software and each response was coded for categorization based on themes which represented the lines of

thought on the status of ehealth at each facility. Limited quantitative data analysis was also conducted using the same software.

The study had several limitations. Firstly, the sampling for primary facilities was not representative of the number of health facilities in the country. Although this was the case, we are convinced that the findings are applicable to all primary facilities as our informed assumption suggests that the operational limitations for these facilities are the same across the country. Secondly, it was difficult to arrange a face-to-face interview for most health facilities during the data collection. In some circumstances the interviewee requested to fill at own time and for the interviewer to return another time/day to collect. Self-reporting in these circumstances may have affected the quality of our results as it removed the opportunity to probe on certain responses. Thirdly, in some facilities, especially private hospitals it was hardly possible to get permission to collect the data.

3   Results

The results have been presented in major themes of Status of policies, data collection and reporting tools; Status of ehealth in health facilities; Health-worker to patient ratio and hospital management capacities; Modes of communication in health facilities in Malawi; Staff training by health facilities; eHealth providers' support to health facilities; ICT technical support to health facilities; Results Discussion.

3.1   Status of Policies, Data Collection and Reporting tools

The assessment identified a number of policies and strategies which are instrumental in supporting the development and implementation of the ehealth strategy. These include the Malawi National ICT Policy, the Health Sector Strategic Plan (HSSP), the Health Sector Handbook of Indicators and the Health Information Systems (HIS) strategy. The assessment also identified a number of health information systems assessment documents which include: Design and implementation of a health management information system in Malawi: issues, innovations and results (2); Development of the Health Management Information System in Malawi 1999-2003 (3); Health Information Systems Assessment Report, 2009 (Health Metrics Network, MoH). In terms of data collection and reporting tools the assessment found that the Central Monitoring and Evaluation Division within the Ministry of Health maintain a serialized coded list of most of the tools used for data collection and reporting.   The assessment also found secondary data collection tools which include program specific reports which are collected periodically based on information recorded is in the patient records. The periodicity of the reports includes weekly, monthly and quarterly. Departments use these reports to monitor programme specific indicators. In total, there are over 30 reports most of which are reported monthly.

3.2   Status of eHealth in Health Facilities.

On the status of ehealth in facilities the assessment collected information on access to information, health surveillance, disease diagnostics, monitoring adherence to clinical practice, stock management, data policy, and monitoring and evaluation.

3.2.1 Access to Information.
In terms of access to information, the assessment found that information is available mostly in the form of registers and patient passports and is easy to have access to these records. However, all facilities indicated that this information is difficult to analyze for decision making since it is available mostly in manual form. Additionally, the assessment found that sharing this information becomes difficult, as some files are moved from one office to another or from health facility to patient homes, resulting in making their tracing difficult. In some cases there is a danger that the files can get missing or end up in the hands of unauthorized personnel who can view the content. The assessment also found that poor inter-communication among facilities contributes to a number of challenges such as problems in getting surveillance data in a timely manner, thereby derailing the response to disease outbreaks. To improve access to information, the assessment found that facilities are willing to adapt to new technologies for managing data and information.

3.2.2 Health Surveillance.
In terms of health surveillance the assessment found that health facilities monitor diseases of public health importance through the Integrated Disease Surveillance and Response system (IDSR). The IDSR mainly relies on data collected by Health Surveillance Assistants (HSAs), who are based and/or work in communities and conduct screening visits for patients at the health facility. 50% of facilities assessed believe that the quality of IDSR performed is inadequate. As part of disease surveillance patient follow-ups are done on diseases and conditions such as PMTCT, ART, MDR, TB, Malnutrition, Malaria, and IMCI using HSAs for community level follow-ups and nurses and doctors at facility level. Most hospitals and health facilities reported loss to follow-ups of between 10% and 30% with the majority between 15% and 25%. Few health facilities, however, reported as high as 90% loss to follow-ups, while other facilities stated that they are not sure because they have no tools with which to ascertain the same.

3.2.3 Disease Diagnostics.
In terms of disease diagnostics, the assessment found that in hospitals and health centres which have lab facilities, tests take between 5 to 30 minutes to be completed. However, some health facilities that do not have laboratories send samples for testing to other facilities, where it takes between 3 and 21 days for the test to be conducted and results delivered. Facilities indicated that the process of referring lab samples could be computerized to reduce this duration. Facilities also disclosed that some lab samples sent for testing are discarded for the following reasons: sputum not correctly collected, clotting of blood because of lack of anti-coagulant, improper storage, wrong record keeping, some samples take too long before being tested, and use of wrong sample bottles. The assessment found that on average health facilities discard between 0 and 5 samples per day. Facilities reported that sample management is improved through clinician handbooks, memos and morning reports on how to properly collect and present samples. Communication between nurses and clinicians also help to improve sample management. Continuous education to nurses and clinicians also help to avoid making errors that would lead to the samples being discarded. As for Radiography department, the assessment found that although radiographs are crucial for surveillance and patient follow-ups, their management has been difficult as patients have to carry them to different departments by themselves, and return them to radiography department after receiving treatment. As a result, most patients end up taking the radiographs home.

3.2.4 Monitoring adherence to clinical practice.
To identify the areas where e-health can support delivery of quality services the study also investigated the processes of monitoring adherence to clinical practice. The study found that health facilities employ various monitoring mechanisms to ensure that best practices are followed in care delivery. Proactive monitoring mechanisms include on the job monitoring which is done mostly through Heads of Departments, quarterly supervision by MoH officials, departmental meetings, joint ward rounds, affiliation with international bodies such as UK NEQAS where samples are received from the UK and test results are sent back to the facility, and registration renewals with Medical Council of Malawi. Furthermore, monitoring is done through use of treatment cards, patient follow-ups, and dots on guarding-base. Peers are also used to monitor each other and sometimes senior practitioners are used to monitor juniors. Additionally, proactive monitoring is done through use of posters in examination rooms, equipment testing, daily morning report, case discussions, using a comprehensive duty roster system. Other monitoring mechanisms include clinical or maternal death audits. Follow-ups on queries are also used as monitoring mechanisms.

3.2.5 Stock Management.
In managing commodities such as medicines, food and stationery, facilities are largely using manual systems such as stock cards, bin systems, manual records, physical checks and periodic stock taking. These have proved to be largely ineffective as virtually all facilities have indicated that they have not been able to avoid stock outs or having expired commodities. But only few facilities indicated that they employ some form of automation ranging from Microsoft Excel spread sheets to Supply Chain Manager System to assist them with stock management. The largely manual systems are clearly not effective in aiding decision making to help management know the correct time, type and quantities to order and what commodities have expired and need to be destroyed. However, some of the stock outs are blamed not on

the manual systems, but on their non-availability at Medical Stores, both regional and central. Other problems mentioned as contributing to stock outs are shortage of well-trained Pharmacists and Stores Officers as well as drug thefts.

3.2.6 Monitoring and Evaluation.

The assessment found that almost all health facilities and hospitals have M&E tools at facility, department or program level. Such tools include patient records such as the registers where details of patient visits are recorded and periodic reports on health service delivery. It was found that these tools have their strengths and weaknesses. On strengths the reports are good as they are done mostly manually and people are forced to review the data in the process. In addition, the tools are able to guide program evaluation and further development, and are also user friendly. The tools capture most of the data, such as age, sex, name and physical address. However, it was found that the tools miss some information which is needed at facility level. As for weaknesses, the tools take time to produce reports, are labor intensive. Additionally, it was found that the current tools need special training to be effective as they are difficult for some users to follow (e.g. attendants). As is well known, due to the fact that most of the tools are manual, storage space is required for all the data or records. Finally, it was found that that some of the tools like registers can go missing or disappear permanently if not well taken care of.

3.2.7 Data Policy.

The assessment found that 75% of health facilities have a policy to guide on access to patient data. However, in most facilities these policies, even though in use, are not documented. In order to access data, people/researchers are asked to go through the DHO's office for approval. Out of the public health facilities and hospitals assessed, it was found that approval is granted by the Hospital Administrator, whereas in case of mission hospitals such as Nkhoma Hospital it is the Medical Directorate which grants such permissions. In some cases researchers or people are referred to the Hospital Director or Research Coordinator, and in referral hospitals, it is only the former who authorizes or denies access to data upon submission of a written request. Researchers are also required to produce written permission from Ministry of Health Research Committee and/or permission from a research committee from their institution, if it is an academic study. The assessment found that measures are typically put in place to ensure that names for patients are not exposed anyhow by adopting confidentiality principles such as implementing a biometrics and Id control system, so that only authorized personnel can access records, even though they are kept in manual format. Furthermore, the health facilities have put in place mechanisms to make sure that people collect only the data they requested. For example, in some facilities they assign a member of staff to accompany the researcher during data collection process, request a Head of Department to be the one to release data to the researcher, or have the researcher get data through the office of the Research Coordinator or Hospital Management. Facilities, however, complained that when data is collected from them, the reports or findings of the study are not shared. It is therefore imperative to put in mechanisms which will ensure that people and researchers should be sharing their findings with the facilities from which they collected the data for their studies.

3.3 Health-worker to Patient Ratio and Hospital Management Capacities.

Table 1 provides a summary of number of health-workers, and patients treated per day, in facilities that participated in this study. On average the number of patients seen per day ranges from 30 to 2,700 varying depending on the size and location of the health facility. The final column shows that the number of staff in different cadres is inadequate to provide services to the number of patients indicated. The health facilities have proposed various ways to improve the staff situation including working extra hours, no off duty for staff, increasing number of staff, Locum, redeployment of staff and training more staff.

3.4 Modes of Communication in Health Facilities in Malawi.

On average, most health facilities especially secondary and tertiary have access to the Internet, cell phones and telephones. About 90% of the health facilities that participated in the study indicated that they have a computer with accessories. 80% of the health facilities have Internet access, telephones and

power generators. It was also found out that the main mode of communication in the health facilities was the use of telephones and e-mails. Use of VIOP and video conferencing was only reported by Nkhoma Mission hospital. Figure 1 shows the distribution of modes of communication in health facilities.

Table 1. Number of Patients and Health Workers

|	# Patients/ Day	Specialist Doctors	GP Doctors	Clinical Officers	Nurses	Midwives	Pharmacy Technician	Lab Technician	Radiography Technician	Adequate Staff?
Area 18 Health Centre	-	-	-	11	13	11	-	11		No
City Centre Clinic	-	-	-	-	-	-	-	-	-	No
MASM Katoto	40-50	0	1	4	8	5	0	4	-	Yes
Mlambe Hospital	70-120	-	2	9	53	-	1	3	-	No
Mzuzu Central Hospital	90-120	12	9	24	21	2	8	18	6	No
Mzuzu Health Centre	201-2500	0	0	20	20	20	20	20	-	No
Nkhoma	129	3	3	14	34	1	2	-	No	No
Nyungwe Health Centre	250	0	0	1	33	-	-	-	-	No
QECH	2,700	39	44	39	161	-	-	-	-	No
Saint John of God	30-50	0	11	77	222	20	11	0	-	No
Salima District Hospital	350	0	1	22	65	-	3	4	-	No
Thyolo District Hospital	-	-	2	23	23	81	2	3	-	No
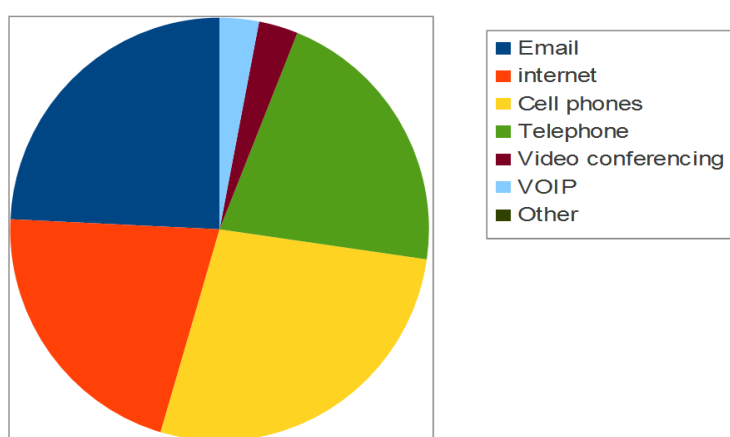
Figure 1. Modes **of Communication in Health Facilities**

3.5 Staff Training by Health Facilities.

The assessment found that some of the health facilities support staff training on ICT. For instance, two of the three central hospitals in addition to one Christian Health Association of Malawi (CHAM), Medical Aid Society of Malawi (MASM) and a private facility indicated having ICT support for their members of staff. The most occurring form of training which facilities reported included e-learning, short term and long term courses. There were no records of staff training support for the district hospital and health centers that participated in the study. In addition, there were also no indications of plans to offer support to staff especially for all the other facilities that reported to have never offered any ICT training support to their staff. In a nut shell, although existence of staff training was reported from almost all the types of health facilities, not all have adequate organization support for ICT development and this is most evident in CHAM, private, district and mission facilities, with the exception of the referral hospitals.

3.6 eHealth Providers' Support.

It was revealed that e-health providers render a number of support services to health facilities. Of all the health facilities assessed at each level, at least one health facility from each level made mention of having a particular support from e-health provider except for one private hospital which reported to have had no support from the e-health providers. The most common e-health providers' support mentioned was users' training and maintenance of the electronic systems implemented. Again, although these were reported from almost all the categories of HFs which we sampled, a comparison of number of facilities that reported presence of support to those that did not indicate revealed that not all facilities have access to e-health providers' support and therefore a gap exists. Central hospitals registered receiving more maintenance and users' support.

3.7 General ICT Technical Support.

Half of the facilities reported having technical support from within. It was indicated that these services were either rendered by local ICT teams or knowledgeable staff. Nevertheless, the assessment also found that some of the health facilities, central, private and district hospitals had their ICT services contracted out. The findings also showed that most technical support for the facilities that indicated to have had, emanated from knowledgeable staff and ICT teams or sometimes both. These were said to be always or sometimes available to the health facilities. It is also worth mentioning that two health centres that we had in our sample did not have technical support. This could be attributed to the nature of ICT they use which do not require much users' support for example radios and cell phones. It could also be due to lack of adequate ICT equipment that necessitates more technical support.

3.8 Decision Making and Information Needs.

The assessment found that health facility staff make many technical and managerial decisions. Technical decisions include clinical case diagnosis, treatment prescription, clinical emergencies, lab sample management, patient follow-ups, patient appointment management, data analysis to come up with different interventions, and referral of patients. Managerial decisions include communication, stock level management of materials and equipment, human resources (e.g. staff allocation), finance/ budgeting, procurement, drug distribution and control, resource mobilization, transport and general logistics, social welfare, evaluating and deciding on needs of the health facility in general (e.g. supplies) and public relations. In order to make these decisions health facility staff needs different information. Technical information is required on patient's medical history, physical examinations, investigation results from the laboratory and radiography, recorded vital signs from nurses and availability of TB samples. Information on outbreaks is useful in making decisions. Written and oral information from all departments including medical services is also required for a clinical officer to collate and generate a monthly report. Managerial information is required on duty roster to show the person on duty, availability of staff, stock levels of each commodity, consumption rates of stocks, required drugs at a facility, availability of services (e.g. where a patient can go to be assisted if a health facility does not have the services), availability of tasks and resources, number of patients and availability of registers. General availability of data on conditions

of service, work policy, resolutions of Internal Procurement Committee (IPC), management minutes and board minutes is also needed. Information is also required on finances, transport utilization (fleet consumption, fleet maintenance, transport requests, fuel returns, and requirements from departments/sections), quotations and cost of living index.

3.9   Status of ICT Governance in Health Facilities.

The governance situation assessment focused on availability of ICT management frameworks, presence of monitoring and evaluation of ICT performance, procedures for operations of ICT in health facilities. Furthermore, assessment was made on strategic planning for ICT projects, presence of Service Level Agreements and ICT skills development within facilities and corresponding change management strategies. On the issue of ICT management framework, all government facilities reported that they had no documented framework for reinforcing ICT use and management. However, some mission and private hospitals had some form of guidelines. At Nkhoma Mission Hospital, for example, the framework is in form of guidelines and rules on usage of ICT services in the hospital which are evaluated from time to time by the ICT committee which comprises two management members for the hospital. Additionally, the Medical Aid Society of Malawi (MASM) is using the Information Technology Infrastructure Library (ITIL) framework as a requirement for all firms governed under the KPMG audit company. At district level, it was found that Chiladzulu, Ntcheu, Dedza, Mchinji and Nkhatabay had no policies guiding usage and support for ICT although some districts have made efforts to spend on resources such as Internet. In terms of monitoring and evaluation of ICT performance, the facilities that were visited did not have any framework for the monitoring and evaluating ICT performance. While there are indications of Policies and procedures for operations of ICT in some CHAM hospitals and referral hospitals, there are none at district level. The facilities that have these policies and procedures have them in either undocumented or documented forms. The assessment found that development partners have been key in putting in place standards for ICT operations in facilities where own standards or guidelines do not exist. It was found at Nkhoma Hospital that they have the following tools to enhance policies and guidelines: ICT department monthly meetings, ICT policy which is in draft form currently, Procurement policy, privacy and confidentiality policy/agreements, quarterly plans and Gantt charts. MASM also has policies and guidelines most of which are of international standards compliance level.

    On management and development of ICT skills, all facilities reported to have their staff undergone one or more types of training. It was noted that most training in government hospitals was on specific systems such as Electronic Medical Records Systems and District Health Information System, among others. However, except for MASM and two CHAM facilities including Nkhoma Hospital which have training plans, there are no regular planned training sessions for building ICT skills although all facilities agreed to a major gap in ICT skills in the facilities. It was found that lack of funds to support staff ICT development was the main cause for lack of training in the facilities. In terms of service level agreements, it was found that the facilities that participated did not have Service Level Agreements for their ICT projects or maintenance of systems except for Nkhoma Hospital and MASM. Although some facilities reported to be in the process of developing SLAs for ICT, there are currently no SLAs for maintenance of computers signed by the health facilities and service providers. It was notably found that because ICT projects are driven from a national level perspective or through development partners any forms of SLAs that are existent at the hospitals were signed by the Ministry of Health with the partners. In terms of change management strategies, although all the facilities did not have a well outlined and defined change management strategy, some facilities especially CHAM and referral hospitals reported having ICT personnel who are instrumental in assessing any software or hardware development prior to implementation. However, for the government referral hospitals, it was found that most of the work is done by the collaborating partners and the hospital management plays less or no roles in the software assessment due to lack of adequate ICT workforce. For MASM, changes to ICT systems have to be formally requested and approved by the National Information Technology Security Officer. Furthermore, some of the CHAM and referral hospitals reported to having a strategic plan documented by its management team and evaluated monthly and quarterly meetings. However, these are general strategic plans with little emphasis on ICT due to lack of financial resources.

3.10   Status of Specific Health Information Systems.

In terms of Logistics Management Information System the assessment found that the Ministry of Health (MoH) through the Health Technical Support Services (HTSS) department has a system for managing pharmaceutical supply logistics. Drug consumptions and requests are sent from health centre to district hospital and from district hospital to National Stock Status Database (NSSD). MoH gets monthly consumption reports from NSSD, which maintains an electronic supply chain management system which is connected to the central system at the NSSD office. At facility level, each facility has a stock card for each drug which is updated every time stocks come in or are taken out. The information on the manual stock card is sent to the district hospital where it is captured into a computer so that consumption reports are produced. Using the consumption report, the district places an order to Central Medical Stores for a refill. The main challenge is that management of information in the pharmacy is manual using the stock cards. Efforts are under way to computerize the pharmacies so that information is managed electronically. Additionally, the assessment found that there is no comprehensive electronic Laboratory Management Information System although partners such as CHAI have a module on Early Infant Diagnosis (EID) in major facilities of the country. The CHAI system collaborates with the Result 360 system which is run through a server at UNICEF to send lab results to remote health facilities by Short Message Service (SMS). It was found that the MoH has a Technical Assistant on Laboratory Management Information Systems (LMIS) who is working on analysis of the status of LMIS in Malawi and will start planning on how to address any challenges soon after the analysis. The assessment further found that electronic Human Resource Management Information System was in advanced stages of development. Similarly, on Physical Assets Management Information System, the assessment found that physical assets are managed centrally in the MoH through the Health Technical Support Services department. The HTSS has workshops at regional level which are available at Queen Elizabeth Central Hospital (QECH), Kamuzu Central Hospital (KCH), Zomba Central Hospital (ZCH) and Mzuzu CH. A Microsoft Access database is used to electronically maintain asset records. Each region maintains its own database which can be accessed at the central level through transfer mechanisms such as flash disks and CDs. Technicians at regional workshop are responsible for collecting data on physical assets and updating their database whenever they visit a health facility. The last time the databases were updated was in 2007 as maintenance activities were stopped due to anticipated policy changes in terms of management of assets in health facilities. However, fresh efforts are under way to resuscitate the system so that fresh updates can start. Three zones have been trained so far in the same Microsoft Access database and plans are underway to train the other zones and key staff at MoH. The wish of the department is that the system should be upgraded so that it can be accessed online. On Electronic Medical Records (EMRs) the assessment found that most EMRs are hospital level is being implemented by Baobab Health Trust and Luke International Norway. These include modules on ART, OPD, General Patient Registration, ANC, Maternity, Chronic Care Clinic module (Diabetes, epilepsy and hypertension), Pharmacy, Billing, In-patient (ADT), TB-ART and Radiology.

3.11   Mobile Applications.

The assessment found that several organizations including UNICEF, CHAI, MSF, Village Reach, Concern World Wide, D-tree and Catholic Relief Services (CRS), Nkhoma Hospital and Chancellor College are involved in mobile health initiatives in Malawi. These initiatives include but are not limited to: Results 360 which aims at delivering EID lab results to rural clinics; Community Case Management (CCM) which is focussed on case management of childhood illness at community level so that more children have access to lifesaving treatments; DHIS 2 Mobile for reporting aggregate service delivery data; Rapid SMS 4 Nutrition with the objective of improving maternal, new born and child health; Child Status Index (CSI) which is a tool for assessing the well-being of children; the C-IMCI which is used to implement the government's community IMCI, the Mother-infant pair (MiP), which is intended to follow up HIV infected mothers and their new born until the child has reached the age of 2, and Chipatala cha pa foni for maternal, neonatal and child health, which is a toll-free case management hotline operating at Balaka District Hospital and provides health information and advice on maternal, neonatal and child health issues to callers who maybe out of reach of Health Surveillance Assistants (HSAs) or other community health education volunteers.

4   Results Discussions

Firstly, this assessment has revealed that most of the challenges faced by health care workers in decision making for quality health service delivery are fundamentally linked to the manual nature of patient records management. Notably, inadequacy of staff as revealed by the assessment has implications on both the quality of data capturing and reporting. While under pressure of work and faced with the challenge of choosing whether to save patients' lives or ensure that data is captured health care workers choose to save patients' lives. In cases where the data was captured, the manual nature of the data makes it difficult for reporting since a health care worker has to take significant time away from supporting patients to go through the patient record books and manually count and tally the results. As a result, most facilities where there are no dedicated statistical staff face challenges to submit periodic health service delivery reports. Additionally, manual reporting affects data quality due to human errors and limits the ability to share and analyze the data for decision making. The recommendation is to computerize patient record book which will help to improve on the human errors and also increase efficiency which will lead to freeing up time for the busy staff. This is in line with the findings of the assessment where facilities have expressed need for computerizing patient management processes. Secondly, another fundamental issue identified by the assessment is the infrastructure challenge. Poor infrastructure is affecting access to information, health surveillance, and patient diagnosis, among others, as reported in the findings. There is need to address issues of intra and inter facility connectivity. Although the mobile phone is the main mode of communication, as reported in the findings, it is difficult to use them for other modes of communication such as Internet and email as mobile service provider network coverage, which is the most scalable and sustainable source of connectivity in Malawi, is not adequate in most facilities. Additionally, there is need to address power problems as most facilities have no access to mains electricity although they have potential sources of energy such us the sun and wind. The third fundamental issue identified in the assessment is the issue of systems integration and interoperability. The assessment results show multiple electronic medical records systems and mobile applications operating at community, hospital and national levels. These systems are running on different platforms and using different hardware devices. With unavailability of meta data dictionary at national level and data standards it is difficult to integrate health data so that different systems are able to share information. There is need to address issues of systems integration and interoperability. The assessment further revealed a fourth fundamental issue hindering the success of ehealth in Malawi as poor policy and governance. As presented in the results many health facilities lack clear policies on use and management of ICT. Where such policies are available, some health workers use them while others do so inconsistently. Lack of clear policies on management of ICT infrastructure and data sources lead to poor resource utilization as it is easy for decision makers to ignore allocation of resources. For example, most facilities have idle computer equipment due to repairable issues such as faulty power supply, hard disks, viruses etc. Poor maintenance of equipment is attributed to lack of budgetary support for ICT services at facility or district levels and lack of appropriate policies are affecting maintenance support as reported in the results. Further, the fact that policy and governance instruments are pushed from a national level, as presented in the results, may affect level of ownership and implementation at facility level. There is therefore need to adequately involve implementers in drafting of any such policy instruments. There is also need to encourage facilities or districts to have clear maintenance strategies for data management infrastructures such as computers and networks. The fifth fundamental issue identified by the assessment is the issue of skills and knowledge gaps. It has been presented in the results that most facilities do not have strategies to develop ICT capacity. As a result, there is generally shortage of ICT workforce with high visibility in public health facilities, than in private and CHAM facilities. This then result in gaps with regard to maintenance and support of ICT in the health facilities. This has effect on the ability by facilities to absorb ehealth initiatives as it is very difficult for health-workers who have had no or limited form of ICT interaction and training before, to use and work with such technologies once they are introduced. There is therefore need for a strategy on how facilities and MoH can facilitate increased ICT skills and knowledge within the sector. Finally but not least, another fundamental issue identified by the assessment is the issue of sustainability of ehealth solutions. As presented in the results there are many ehealth solutions including mobile applications operating at community, facility and national levels. However, the majority of the current initiatives do not have a very clear sustainability model and plan. Most ehealth solutions are in pilot stage and have remained there for a long time without a clear plan for

scale up. While acknowledging that sustainability is a process that occurs over time and is a question of degree, it is essential for MoH and partners to clearly agree and spell out how e-health programs, as well as activities and their benefits, at different levels within the health sector, should be sustained.

This assessment has highlighted key issues that need to be addressed by the ehealth strategy. First, there is need to address the issue of harmonization of data collection tools to bring about efficiency and cost reduction. Second, there is need to computerize data collection and analysis processes for efficiency to help free up time of healthcare workers from doing repetitive assignments. Computerization will also be instrumental in improving quality of data. Third, the ehealth strategy should include how the issue of poor infrastructure will be addressed. The assessment has shown that there is need to address poor communication and power supply infrastructures. Fourth, the assessment has shown that there is need to address issue of interoperability and integration of systems. Fifth, but not least, there is need to address the issue of governance of ICT infrastructure and resources through development and implementation of relevant policies and guidelines. Finally, but not least, the ehealth strategy should include how to address the issue of sustainability of systems in the long term.

5   Conclusions

This report has presented the methodology for ehealth strategy assessment and main issues to be included in the assessment. The assessment has identified a number of key areas which should be included in the ehealth strategy in order to strengthen the delivery of health services in Malawi. The main issues identified include: manual management of health service delivery data which leads to inefficiencies in decision making, poor ICT infrastructure, inadequate and unreliable power supply, lack of integration and interoperability of systems, lack of adequate ehealth governance and policy instruments, among others. There is need for strategies to address these issues.

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A successfully handed over Master of Public Health in Health Informatics Program at University of Gondar, Ethiopia

Atinkut Zeleke[a*] ,Binyam Tilahun[a,b] , Desalegn Zegeye[a] , Mulusew Andualem[a], Mihretu Molla[a],

Solomon Assefa[a], Tesfahun Melese[a]

[a] Department of Health Informatics, University of Gondar, Ethiopia
[b] Institute of Medical Informatics, University of Münster, Germany

Background and purpose:Managing the health system using reliable information for decision-making is a priority to all countries. The need for graduate-level health informatics training for health care professionals, who are capable of producing or facilitating the system, is a crucial, and often overlooked, aspect for the health information systems' management within ministries of health. To satisfy the need of those professionals in Ethiopia, a Masters Public Health in health informatics program was started in Gondar University in 2007. In this article we want to share the curriculum content and how we successfully handed over the program to successful run it with local capacity.

Objective: The purpose of this paper is to describe the Masters of Public Health in Health Informatics Program at University of Gondar, Department of Health Informatics and to share our experience how we successfully handed over the program to successful run it with local capacity with HELINA health informatics community.

Methods: We reviewed Masters of Public Health in Health Informatics program of University of Gondar based on expert analysis of the curriculum content; competencies of graduates; the graduate working condition, and the success and challenges of the program. Additionally we compared the curriculum with IMIA's recommendation for health informatics education for validation against an internationally recognised standard.

Results: The program is a two-year graduate-level program with a total of 35 credit hours in operation since 2007/2008 using sandwich (one month in campus and then two months in practical organization in their respective organization) course delivery methods. The program consists of public health-oriented health informatics competencies. Most of the students' thesis research completed focused on assessing the data management activities of the health sectors using cross-sectional study design. All the graduates are working institutions such as higher education, research centres, and plan and program offices in the health sectors.

Conclusions: This public health-oriented masters program is contributing to the national health care human resource pool from the academic institutions to service delivery organization. The program was under NOMA funding until 2012, but after that we were able to successfully handed over the program and run it with local capacity. Proper management and building local capacity during funding period are very important factors to successfully hand over funded programs to the local capacity. We also believe that important lesson can be shared for the African health informatics community.

Keywords: health informatics education, Ethiopia, masters, public health informatics, Developing country

1   Introduction

Globally, there is increasing interest in the measurement of indicators to capture key information about disease treatment and prevention programs. This reliance on indicators necessitates quality assurance mechanisms that promote reliable data collection, storage and management. Information technology has the capability to improve the way public health is practiced [1-3]. Fortunately, the technology necessary for effective, innovative application of information technology to public health practice is available today

at very reasonable costs. However, realization of this potential is possible only with a workforce ready to use these technologies appropriately.

Like other the developing countries[4], in Ethiopia the management of Public Health care data is reportedly of low quality. [5] Much of the data collected and reported at each level of the health system are not complete, timely, or of good data quality. Even though it may not be the only reason, the issues related to the data quality can be linked to the lack of professionals to manage the health care data collection, analysis, reporting and the corresponding systems [6, 7].

To improve the quality of data and healthcare information available for reliable decision-making, the Institute of Public Health in the College of Medicine and Health Science at the University of Gondar developed a unique Masters of Public Health Informatics program to train healthcare professionals to manage the health care data management system. This unique health Masters of Public Health Informatics program is the first of its kind in Ethiopia. The Program was developed in collaboration of University of Gondar, under the Project support from the Norwegian Agency for Development Cooperation (NORAD) with a project called Noma, an Integrated Masters in Health Informatics Program. In addition to this program, the Noma Project also involved in collaboration with Addis Ababa University in Ethiopia ,and Dar es Salaam University in Tanzania. The University of Gondar program is a public health specialty program, which is under masters of public health programs in the Institute of Public Health, while the other two programs are MSc in Health Informatics programs and are not part of public health programs. The aim of this paper is to review this Masters of Public Health in Health informatics program so that other countries, which plan to start such a program, may benefit from the example.

2   Study Setting and Methodology

University of Gondar is one of the oldest medical and health Science College in Ethiopia. It is located 729 km away from the capital city of Addis Ababa. The Institute of Public Health, established in 1954, is the foundation of the University. Currently the Institute delivers teaching, research and consultancy service in public health. This Masters in Health Informatics program has been operating at University of Gondar for the last 6 years.

The methodology we used in this study was a document review and expert analysis of the contents and comparison of the curriculum with IMIA recommendation on health informatics education. We review the curriculum objective, course content and graduate profile of the students with respect to other programs and IMIA's recommendation[8]. The criteria's of evaluation were selected from competency recommendation areas of IMIA document. Based on those competency areas each of the courses and expected skills with expert opinion was conducted.

3   Result

Modular based sandwich program (a program with a month and half block course in the campus and a month and half off the campus for in job course-related work) was developed under Institute of Public Health. To develop the curriculum and related program issues, experts from Institute of Public Health at the University of Gondar visited the Leicester University in the UK to learn from their experience in developing a similar public health program. To start the program in our university, short-term capacity training was given to senior public health experts and some courses were delivered by expatriate staff in collaboration to internal staff to increase the capacity of the University to run the program with its full capacity. During the first five years, the Department used the funding opportunity to provide more study opportunities for theDepartment staff to expand their knowledge and skills in (informatics?) and build our local capacity.

The main curriculum has two parts: 1) the common, or core, public health modules and 2) specialty track specific modules. The specialty track includes the following specialities: public health nutrition, reproductive health, health promotion, and environmental health, epidemiology and biostatistics, health service management, and health informatics. The curriculum was designed this way because the new program is a speciality in health informatics from the general public health discipline. The students first complete the common, or core, public health courses with other public health students and then they complete the specialty course for a Masters of Public Health degree in Health Informatics.

The overall Program structured to be completed within 2 years. The Program allocates one and half years for common, or core, modules and half year for track specific modules. These modules are aimed at providing specific knowledge and skills leading to expertise in health information system management and decision-making skills. Unlike the other masters-level programs, which are semester-based, this program is a sandwich program using block course delivery system. The sandwich program was developed to be considerate of the need for health care professionals to gain higher education degrees without leaving their working environment. The students take at least 2-3 courses with a maximum of one month in the Institute then they are allowed to return to their workplace to do their jobs and course-specific practical assignments, which they should submit before the next round of modules. These course specific assignments are usually related to their working environments. This helps the students to relate the classroom study with the real work environment in their work places.

When they return to the university, they submit their assignment and take their examination. Then they start their second round course. This cycle continues until they finish all the courses except their thesis. The thesis takes a maximum of 6 months and focuses on their specialty or specific research thematic areas.

3.1   Program objective and competencies

The objective of the program is to produce competent health informatics professionals that can support the public health and health informatics practices, research, and teaching in the country. The program has two basic competency domains: Public Health and Health Informatics.

Table 1. Expected Public Health Competencies from Program Graduates

Public Health Competencies
• Provide effective technical as well as managerial leadership in large public health programs
• Effectively advocating and promoting public health among the general public and policy makers
• Design, implement, monitor and evaluate public health interventions
• Generate as well as critically evaluate health and health-related evidence
• Utilize theories and skills in public health research
• Make evidence based decision in public health issues
• Identify major public health problems in Ethiopia
• Undertake health research and interpret findings
• Utilize research findings in clinical and public health practice

The competencies in Table 1 are for all Masters of Public Health Program students, regardless of their specialty difference. During their second year, they start their speciality courses with a list of separate competencies as explained in the Table 2.

Table 2. Expected Health Informatics Competencies from Program Graduates

Health Informatics Specialty Track Competencies
• Identify basic principles and concepts of health Information systems and apply them in the context of Ethiopia and other developing countries through the use of real data
• Design, develop and implement health information systems
• Use concepts of minimum data sets based on indicators, data collection tools, data accuracy, functional analysis, presentation and interactive report writing to manage health care statistics
• State the core concepts and technologies of health informatics, including terminology, data standards, privacy and security as well as development and implementation tools and strategies
• Introduces the policy context of health information technology, potential benefits and perspectives on future directions.
• Discuss concepts, approaches, and techniques in database management systems (DBMS): relational databases, querying and updating a database
• Conduct health informatics research

These competencies are achieved in the second-year period of the program through health informatics specific courses and their thesis work.

3.2   Course content

The courses are divided as first-year major MPH courses and second-year Health Informatics speciality courses. The students take the first year major courses with other MPH students and they take the speciality health informatics courses in their second-year separate from the other MPH students. All of the courses have their own specific learning objectives to reach the identified competencies and common grading system. Some of the courses are prerequisite for the others,

Table 3. List of courses in their 1st year of study

Year /Round	Course title	Course number	Credit hour(duration)
First Round First Year	Introduction to Public Heath	PuHe605	02 (1 week)
	Epidemiology	PuHe601	04 (2 weeks)
	Biostatistics	PuHe602	04 (2 weeks)
	Health Service Management	PuHe603	04 (2 weeks)
	Qualitative Research Methods	PuHe604	02 (1 week)
Total Credit Hours			16

Table 4. List of Courses on 2nd year health informatics specialization tracks

Year /Round	Course title	Course number	Credit hour(duration)
Second round Second year	Health Informatics-an introduction	PuHe 726	3(2 weeks)
	Advanced Topics in Health Informatics	PuHe 727	3(2 weeks)
	Health Informatics Design and Development	PuHe 728	3(2 weeks)
	Research Methods	PuHe706	02 (3 weeks)
Third round Second year	Thesis	PuHe707	06 (6 months)
Total Credit hours per year			17

3.3   Program Management

The program is managed by the Department of Health Informatics and Institute of Public Health. The university already has a well-established public health and medical school which help the program to integrate well and to get expertise for public health related course.

It is also common that most external funded programs in Africa are unable to sustain themselves after the funding period expires. Aware of this and motivated by the need of the country, we developed the capacity of the department in the way that the program can sustain itself when the funding expires. Each year we hire first degree holders either in health or informatics and train them in the master's program.

Among the 8-10 students we admit every year, we provide 2 to 3 slots to the institute of public health staffs to build capacity within the program. Other facilities and research expenses of students are covered by the university like other public health programs. So these activities that demonstrate the strong support of the University officials and Ministry of Health helped us to successfully hand over the program.

3.4   Comparison of our curriculum with IMIA's Recommendation

IMIA recommendations for the health informatics education basically have two categoriesIn the first category are recommendations for courses with a focus on health informatics for medical and health schools or colleges with aim to enable health care professionals become good Information systems users. The second category is concerned with the recommendations of courses for dedicated educational programs in health informatics in order to prepare graduates to become health informatics specialists.

   IMIA recommends that masters-levelprograms accept students with one of following educational degrees: A bachelor degree in health information management, a bachelor degree in medicine or health sciences and a bachelor degree in computer sciences. We have been accepting students from a bachelor degree in health care, statistics, computer science, or information technology backgrounds.

   The Program is a research based Masters program that includes a research project after completion of interdisciplinary course work in public health and health informatics areas. Most of the IMIA's recommendation focuses on the structure and content for applied health informatics program, with an emphasis on health informatics. Our program is more of a public health oriented Masters in health Informatics program with more focus in public health.

   The graduates from programs built on the IMIA recommendations are expected to be very technical. Graduates from our program usually take aless technical but more managerial role. This may have happened because our curriculum does not offer the number and the type of health informatics courses and the contact hours for each courses as are available in other programs.

4   Discussion

The competencies from this program are unique for Ethiopia and most of the developing counties. The many programs in other countries are focused on health informatics science with no or little emphasis in the public health competencies.[9]. Our program schedule using the sandwich approach, on the other hand, has been very favourable of the scarce health professional to do their postgraduate studies while they are still in their work place. From our experience, this schedule helps many of our students to become interested in our program and in what they are learning

   Even though there is no country wide study about the impact of this program on the national health care data and system management we believe the program supports the health care strategy of the county. Most of the graduates are placed and working at higher levels in the country health care system from federal Ministry of Health to academic and research institutions. As some of the graduates of this program are working in our department, the department has witnessed the graduates contribution for the development of the new, and only, Bachelor of Science in health informatics in the history of the country [10]. Currently, the program is under revision to use competency based program approach, which is being incorporated in most postgraduate programs at the University. In 2012, the MPH in Health Informatics program has successfully transferred from project funded program to university owned program. Now, the program is fully funded by Ministry of Education though the University of Gondar. This implies the program is on track to provide a sustainable program stream to develop informatics skills in healthcare professionals in Ethiopia.

   As a health informatics education program still in infancy stage in Ethiopia, the Program is highly challenged due to the shortage of appropriate qualified faculty to deliver courses, advise students' thesis and evaluate the thesis. The alternative has been to invite external staff from national and international academic institutions to support these activities.

   Our program is in-line with most of IMIA recommendations in terms of program duration, course structures, and some of the basic health informatics specific courses. The program however, needs more informatics courses which are already outlined in the IMIA recommendations[8] .This may be attributed to the fact that the Program objective is focused on training of less technically competent but more managerial skillful public health professionals to manage the health information system of the country.

But based on our programmatic review and graduates feedback, in the future we plan to add some more additional informatics courses.

5   Conclusion and recommendation

This public health oriented masters program is contributing to the human resource need of the country by teaching advanced level informatics course to public health practitioners so that they can contribute to the current health information system development plan of the country.

The Program was under NOMA funding until2012, but since then we have been able to successfully hand over the Program and run it with local capacity. Proper management and building local capacity during funding period were very important factors to the successful hand over of the funded program to the local capacity. We also believe this is an important lesson to be shared for the African health informatics community.

Our way forward is to make sure that the program meets its objective of building local capacity to improve health information systems and health outcomes. To achieve this, . we propose a detailed impact assessment study on the effect of the program on the country health system and on the assessment of the graduate's contribution to the current health information management system in the country.

In this paper, we present our 6 years' experience of running this program. We believe that important lessons from the challenges and success of this program can be used by other African countries.

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Le rôle des NTIC dans le développement des mécanismes d'assurance maladie en RDC

KARARA Gustave[a*], AMISI Fataki Clément[b], SHAMASHANGA Pierrot[c], VERBEKE Frank[a], NYSSEN Marc[a]

[a] Department of biostatistics and medical informatics, Faculty of Medicine and Pharmacy, Vrije Universiteit Brussel, Brussels, Belgium
[b] Département des Mathématiques et Informatique, Faculté des Sciences, Université de Kinshasa, Kinshasa, RDC
[c] Centre Scientifique et médical de l'Université Libre de Bruxelles pour ses Activités de Coopération, Kinshasa, RDC

Contexte et objectif: La République Démocratique du Congo (RDC) a` décidé depuis 2010 d'adopter une loi sur l'assurance maladie universelle en institutionnalisant une Agence Nationale d'Assurance Maladie (ANAM) et les Mutuelles de Santé (MS) créées au niveau de chaque zone de santé. La loi est toujours en cours d'élaboration mais un Programme National de Promotion de Mutuelles de Santé (PNPMS) a été mis en place et quelques expériences mutuellistes ont été recensées même si la pénétration au niveau de la population reste très faible (2%). Par cette étude, nous voulons démontrer que la gestion de ces organisations d'assurance maladie (OAM) devra faire appel aux Nouvelles Technologies de l'Information et de la Communication (NTIC).
Méthodes: La méthode TOGAF (The Open Group Architecture Framework) pour l'élaboration d'une architecture d'entreprise a été utilisée pour définir le rôle potentiel de l'informatique dans le développement des mécanismes d'assurance maladie.
Résultats: Le fonctionnement d'une OAM tant nationale (ANAM) que communautaire (MS) passera par des mécanismes de gestion informatisée. L'architecture applicative de la gestion de l'ANAM et des MS décrit la gestion des adhésions, cotisations et prestations et le suivi de l'évolution d'un nombre d'indicateurs de performance.
Le développement de ces OAM nécessitera la mise en place d'une gestion coordonnée d'un nombre de données chez les assureurs, les prestataires de soins et au niveau central du Ministère de la Santé Publique (MSP). Les solutions informatiques de gestion d'assurance maladie doivent de préférence être génériques, simples et robustes, basées sur le web et avec des codes sources libres.
Conclusion: L'étude montre que même si l'expérience de l'assurance maladie est encore jeune en RDC, il est recommandé de déjà réfléchir sur les outils informatiques de gestion qu'il faudra implémenter afin d'améliorer la gestion des différents mécanismes d'assurance maladie au sein de l'ANAM et des MS.

Keywords: Mots clés Informatisation, TOGAF, Organisation d'assurance maladie, RDC

1   Introduction

Vers les années 2000, la République Démocratique du Congo (RDC), en ligne avec la majorité des pays africains, a initié l'approche de développement de l'assurance maladie basée, dans la communauté, sur les mutuelles de santé [1]. Le Programme National de Promotion des Mutuelles de santé (PNPMS) a été créé en 2001 au sein du Ministère de la Santé Publique (MSP) [2].

En 2005, tous les états membres de l'Organisation Mondiale de la Santé (OMS) ont décidé d'atteindre la couverture universelle en matière de santé en utilisant les différents mécanismes d'assurance maladie. Le but de cette Assurance Maladie Universelle (AMU) est de faire en sorte que tous les individus aient accès aux services de santé sans encourir des difficultés financières [5,6]. Elle s'inscrit dans une vision globale de lutte contre la pauvreté [4].

Pour atteindre l'AMU, 3 options sont présentées [7,8,9,10]:

— Rendre obligatoire l'assurance maladie pour l'ensemble de la population, option qui renforce la solidarité et l'équité de l'accès à la santé
— Instaurer une contribution fiscale nationale indépendante des salaires pour financer l'AMU : il s'agit d'une contribution à l'assurance maladie par la taxe sur la valeur ajoutée ou autre taxe additionnelle spécifique surtout sur des produits qui sont nuisibles à la santé comme le tabac, l'alcool, le carburant,…
— Améliorer la connaissance des avantages de l'assurance maladie auprès des populations et faciliter leur adhésion: cette option vise à étendre la couverture de l'assurance maladie dans le cadre de la stratégie de promotion des mutuelles de santé (MS)

Depuis 2010, la RDC a lancé un chantier de rédaction et d'adoption d'une loi sur l'AMU. Pour mettre en place cette assurance de partage de risques de santé, la RDC a fait le choix de 2 systèmes d'assurance [1,11]:

— Agence Nationale d'Assurance Maladie (ANAM: établissement public doté d'une autonomie de gestion), qui serait un système obligatoire.
— Mutuelles de Santé (MS), initiatives communautaires, articulées aux Zones de Santé (ZS).

Le financement de ce système d'AMU proviendra des cotisations des affiliés, du financement public à travers d'un Fond National d'Assurance Maladie (FONAM) alimenté par des taxes supplémentaires incorporées au produits nuisibles à la santé et des cotisations des employeurs du secteur formel [1,11]. Il est également prévu de définir un paquet de prestations de base couvert par l'assurance obligatoire, des conventions entre l'ANAM et les formations sanitaires (FOSA), la mise en place de mécanismes de contrôle et l'instauration d'un ticket modérateur pour dissiper la surconsommation des soins de santé.
La loi sur l'AMU est en cours d'élaboration mais quelques expériences mutuellistes s'observent à travers le pays. Vers fin 2013, 54 ZS avaient initié une MS mais le taux de pénétration reste très faible au niveau de la population (2%) [1].
    La gestion de ces systèmes d'assurance maladie et des structures participatives en RDC demandera l'utilisation des systèmes informatiques de gestion pour mieux orienter leur implémentation et leur fonctionnement, et suivre l'évolution de la couverture universelle en soins de santé. Dans cette étude nous proposons une architecture entreprise informatique d'un système d'assurance maladie pour la RDC. Nous analysons ensuite les opportunités, défis et solutions et proposons un plan d'implémentation et de gouvernance de ce système d'AMU.

2   Matériels et Méthodes

De Juin à Octobre 2014, le Ministère de la Santé Publique (MSP) de la RDC a lancé une étude sur l'élaboration d'un Plan National de Développement Informatique de la Santé (PNDIS). L'objectif était d'établir une architecture entreprise e-santé pour le MSP. Une analyse exhaustive du fonctionnement du système de santé et des besoins en informatisation des structures de santé a été réalisée [12]. Dans cette étude nous allons nous focaliser sur l'analyse faite, dans le cadre du PNDIS, des mécanismes d'assurances maladie et leurs interactions avec les FOSA. Nous avons tiré des informations des visites et interviews semi-structurées réalisés aux différents niveaux du MSP de la RDC :

— Au niveau des Directions du Secrétariat Général et des Programmes Nationaux dont le Programme National de Promotion des Mutuelles de Santé (PNPMS),
— Au niveau des Divisions Provinciales de la Santé (DPS) et des hôpitaux provinciaux
— Au niveau des Zones de Santé (ZS) et des Hôpitaux Généraux de Référence (HGR)

    Les provinces qui ont été visitées sont celles du Bas-Congo (5 ZS et 6 hôpitaux), du Katanga (12 ZS et 14 hôpitaux), du Nord-Kivu (10 ZS et 13 hôpitaux), du Kasaï Occidental (18 ZS et 20 hôpitaux) et de la Province Orientale (10 ZS et 12 hôpitaux). Au total 10,6% des ZS et 10,4% des hôpitaux de la RDC ont été visités.
    La méthode de développement de l'architecture du système d'assurance maladie s'est basée sur l'outil TOGAF (The Open Group Architecture Framework). Dans ses principes, le TOGAF est destinée à créer

une architecture d'entreprise dans le but d'améliorer les performances lors d'évolutions informatiques au sein d'une organisation [21].

Nous avons appliqué les différents éléments du cycle ADM (Architecture Development Method) du TOGAF au développement d'OAM en RDC. Ce cycle est constitué d'une phase préliminaire et de huit phases (nommées de A à H) permettant de construire les architectures métier, applicative, des données et technologique, de planifier leur implémentation, la mise en œuvre et finalement, la gestion des changements à opérer dans une organisation [13].
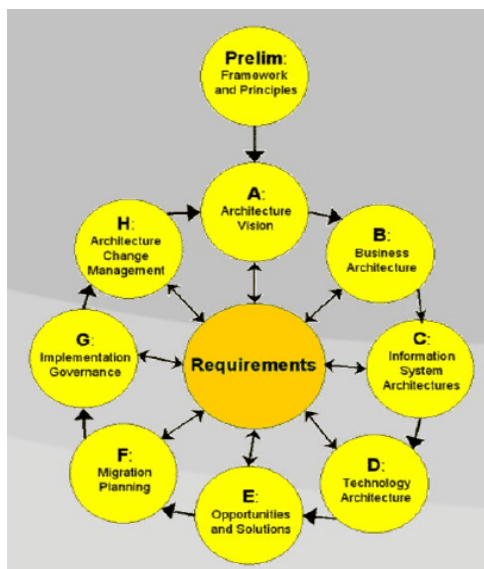
Image 1: Cycle ADM (The Open Group, 2008)

3   Résultats

3.1   Phase préliminaire

Les sources d'informations importantes utilisées pour le développement du plan préliminaire ont été:

— Le Plan National de développement Sanitaire (PNDS, 2011-2015)
— Le document de la Stratégie de Croissance et de Réduction de la Pauvreté (DSCRP 2, 2011-2015)
— Le rapport de l'atelier sur le financement et la qualité des services de santé (Oct 2012)
— Le rapport technique du Plan National de Développement de l'Informatique de Santé (PNDIS, Oct 2014)

La vision actuelle de la RDC est l'établissement de l'AMU qui passe par :

— Une assurance maladie obligatoire gérée par une Agence Nationale d'Assurance Maladie (ANAM)
— Les Mutuelles de santé (MS) centrées sur les Zones de Santé (ZS)

Actuellement quelques expériences des MS existent dans une cinquantaine des ZS mais le taux d'adhésion reste très bas (2%) et L'ANAM n'a pas encore été institutionnalisée.

Le PNPMS a été créé dans le but de promouvoir les MS afin de permettre l'accès facile aux soins de santé de qualité d'ici 2020-2025. L'un des rôles assignés au PNPMS est de créer et gérer une banque de données sur les MS afin d'obtenir des indicateurs sur le niveau de mutualisation des risques, l'accès aux soins et le financement communautaire de la santé. Il joue entre-autre le rôle normatif, de supervision, de facilitation, de mobilisation sociale, de formation et du plaidoyer pour la promotion des MS. Les faiblesses signalées par le PNPMS lors de notre visite étaient liées :

— Au manque d'outils de gestion centralisés pour le suivi des MS,
— Au taux de pénétration très faible de la mutualisation des risques de santé
— A une faible conscientisation de la politique sur le rôle des MS dans le développement économique

— A l'absence de la connexion internet et d'outils informatiques adéquats
— Au système d'archivage papier non organisé
— A l'absence de partenaire structurel

Dans cette étude nous nous sommes focalisés sur les mécanismes, définis par les auteurs [7,14], qui sont utilisés dans la gestion d'une organisation d'assurance maladie (OAM). Ces mécanismes définissent les principes de base d'une bonne gestion et de suivi des activités d'une OAM qui sont :

— La sécurisation du système d'inscription et d'identification
— La sécurisation de la collecte et de la gestion des ressources
— La définition du paquet des soins et de services essentiels
— La définition des modalités d'achat et de remboursement des prestations en hospitalisation ou en ambulatoire
— Le contrôle de dépenses pour les médicaments et les examens médicaux techniques
— La gestion de la carte sanitaire pour assurer la couverture géographique optimale
— La gestion de la qualité des soins de santé
— La lutte contre la corruption et les abus
— L'amélioration des capacités de gestion administrative et financière à la fois au niveau de l'OAM et des FOSA.

3.2   Vision de l'architecture

Le mandat d'une OAM est de permettre aux individus et leurs ayants droit de faire face aux conséquences des risques économiques, sociaux et financiers causés par la maladie. Cette solidarité des uns et des autres pour partager les mêmes risques entre les membres, assure l'autofinancement de l'assurance et joue un grand rôle en matière d'accès et d'utilisation des soins de santé [5,9].

Depuis 2010, la RDC a lancé une réflexion sur la rédaction et l'adoption d'une politique établissant l'AMU. Pour ce faire, au niveau des réformes du financement de la santé, le PNDS propose dans son résultat 3 de mettre en place un programme de la couverture universelle des soins de santé. Les actions proposées sont de promouvoir les MS délocalisées au niveau des ZS sous l'impulsion du PNPMS et de développer l'assurance maladie obligatoire avec des agences locales pour couvrir un régime général universel sans distinction socioprofessionnelle et garantir l'accès à un paquet de soins et services essentiels [15]. L'émergence d'une MS en RDC est due à l'impulsion de la communauté par les responsables d'opinions (autorités administratives, congrégations religieuses, chefs de village,…) et appuyée dans la gestion par le bureau central de la ZS.
Nous nous sommes focalisés dans notre travail architectural sur une OAM centrale créée au sein du MSP et les structures mutuellistes développées au niveau des ZS.

3.3   Architecture métier

L'architecture métier va définir les mécanismes de fonctionnement d'une OAM et les processus métier à mettre en place.

Sécurisation du système d'inscription et d'identification.
En RDC l'identification unique se réalise par la carte d'électeur pour ceux qui ont atteint l'âge de voter (à partir de 18 ans). Cela fait que les enfants et les non-résidents restent en dehors de ce système.
Au niveau des MS et des FOSA, il n'existe pas de système fiable et global pour l'identification unique de l'affilié et du patient. Il y a donc un besoin d'identification unique des affiliés et de leurs ayant-droits. Il faudra pouvoir différencier clairement 2 affiliés d'une même MS et si possible de garder le même numéro en ayant changé de ZS.

Sécurisation du système de collecte et de gestion des ressources.
La collecte et la gestion des cotisations est un point crucial pour une assurance-maladie. La démotivation pour participer à une mutualisation des risques de santé est parfois due à la mauvaise gestion de la MS. La période de collecte des cotisations est liée à une période dans le temps (mensuelle,

annuelle, saisonnière,…). Il faudra pouvoir gérer ces cotisations des adhérents et les différents modes de perception des recettes (cotisations, retenus sur salaires,…).

Gestion du paquet de soins et de services essentiels.

Nous avons recensé 3 types de facturation au niveau des FOSA en RDC :

— La facturation par acte où le patient paie pour chacun des prestations et services de santé reçus
— La facturation par épisode où le patient paie pour un ensemble de prestations réalisées lors d'un épisode de maladie comme la malaria, une fracture de la jambe,…
— Le forfait qui est actuellement prôné par les partenaires financiers du secteur de la santé, se base sur le principe de payer un montant fixe pour une consultation ou pour une hospitalisation où tous les examens médicaux, paramédicaux, médicaments, séjour d'hospitalisation sont compris dans ce forfait. En 2013, 164 ZS avaient mis en place une tarification forfaitaire dans les FOSA [1] et 8 ZS sur les 10 visitées dans la Province Orientale, pratiquent également cette tarification forfaitaire.

Il faudra ainsi trouver des systèmes informatiques pour gérer la consommation de soins des patients et établir la part du patient et la part de l'OAM.

Définition des modalités d'achat et de remboursement de prestations en hospitalisation ou en ambulatoire.

Les conditions de remboursement des prestations sont définies dans le contrat établi entre l'OAM et l'affilié. La prestation de soins doit être très bien définie avec une codification unique. La nomenclature des prestations fait défaut dans les structures de santé en RDC. L'utilisation des systèmes informatiques de gestion d'assurance maladie devra faire recours à une telle nomenclature pour améliorer l'équité dans le remboursement de soins en évitant de confondre une prestation avec une autre et en remboursant les services réellement rendus par les prestataires.

Contrôle de dépenses pour les médicaments et les examens médicaux techniques.

Le remboursement des médicaments et des examens médicaux techniques constitue la dépense principale de l'assurance maladie. Un contrôle efficace des soins s'impose pour éviter la surconsommation de ces prestations. Le système informatique à mettre en place devra suivre, patient par patient, le niveau de consommation de ses soins pour aider à les limiter si possible. Inutile par exemple de faire plusieurs échographies de suivi de grossesse alors que l'assurance maladie a décidé de ne rembourser que 3.

Gestion de la carte sanitaire pour assurer la couverture géographique optimale.

La carte sanitaire permet une répartition judicieuse des infrastructures, des équipements et des ressources humaines sur l'ensemble du territoire. C'est également un instrument de planification, car elle définit le nombre d'hôpitaux et de centres de santé existants, à équiper ou à construire, ainsi que le nombre et le profil de personnel à recruter pour répondre aux besoins. Pour les assurances maladies c'est important de mieux connaître les FOSA de la zone de rayonnement et de documenter la situation géographique des affiliés par rapport aux services de santé.

Gestion de la qualité des soins de santé.

La qualité des soins de santé constitue le pilier principal de tout système de santé. C'est un élément qui entre dans la contractualisation entre les OAM et les FOSA. Elle est évaluée par le Système National d'Information Sanitaire (SNIS). La qualité de données du SNIS n'est actuellement pas bonne. Le canevas du SNIS est complété mensuellement mais contient beaucoup d'indicateurs (plus de 20 pages) pour en lasser le personnel de santé chargé de le remplir. A part le SNIS, les canevas des programmes de santé sont également complétés alors que 80% des informations demandées se trouvent déjà dans le SNIS.

La gestion de la qualité de soins devra faire appel à un système de collecte d'informations en temps réel, c'est-à-dire un système qui est utilisé comme outil de travail au quotidien et qui génère à la fin d'une période les statistiques voulues du SNIS. De ce fait les soins au patient resteront au centre de l'activité des FOSA.

Lutte contre la corruption et les abus.

L'interaction directe entre le soignant et l'usager par le cash est le nœud du problème des pratiques de corruption dans les FOSA. Le malade complote avec le personnel de santé pour payer l'argent qui n'entrera pas dans la caisse. L'assurance maladie protège le patient contre cette corruption et contre les abus de toute sorte liés aux activités de santé dans le secteur informel.

Le taux actuel d'utilisation des services de santé est faible en RDC. Par exemple, en Province Orientale, le taux d'utilisation des services curatifs est en moyenne de 34% dans les 10 ZS visitées et le taux moyen d'occupation des lits est de 48% dans les 12 hôpitaux visités de la province. La population a tendance à se faire soigner dans le secteur informel chez les tradi-praticiens ou même des charlatans.

Un système informatique offrant plus de traçabilité dans le circuit et la facturation du patient pourra améliorer la lutte contre la corruption.

Amélioration des capacités de gestion administrative et financière à la fois au niveau du tiers-payant et des formations sanitaires.

La gestion administrative et financière de l'OAM et des FOSA fait appel aux besoins métiers suivants :

— La gestion du dossier du patient et de l'affilié
— La gestion financière des données d'assurance maladie, de la facturation, des caisses et de la comptabilité générale et analytique et du budget
— La gestion de la pharmacie
— La gestion des examens de laboratoire et d'imagerie médicale
— La gestion des archives des dossiers
— Le rapportage et la production des statistiques
— La possibilité de simuler l'effet de la modification de certains paramètres (montants des cotisations, taux de remboursement, prestations couvertes etc.) sur la rentabilité et la viabilité de l'OAM

Le système informatique à implémenter devra permettre d'assurer une meilleure gestion administrative et financière de l'assurance maladie.

3.4   Architecture des systèmes d'information

Architecture applicative.

L'architecture applicative de la gestion d'assurance maladie couvre la gestion des adhésions, cotisations et prestations et le suivi mensuel de l'évolution d'un nombre d'indicateurs permanents (population couverte, coûts moyens, fréquences d'utilisation, etc.) ainsi que des indicateurs d'évaluation.

Cette application aura des interactions avec d'autres applications du MSP comme le Système d'information hospitalière (SIH), le Système d'information géographique (SIG), le District Health Information System version 2 (DHIS 2), la plate-forme de communication électronique et l'agenda électronique, la comptabilité générale et analytique, les solutions d'analyse statistique et de contrôle de qualité de données, la gestion des ordres professionnels, la bibliothèque numérique et la téléconsultation et télé-expertise.

Architecture des données.

Le développement de programmes d'assurance maladie à travers les OAM ou les MS nécessitera la mise en place d'une gestion coordonnée d'un nombre de données chez les assureurs, les prestataires de soins et au niveau central du MSP:
Au niveau des OAM :

— Gestion des adhérents et des ayants droit
  • Données démographiques de l'adhérent avec identification unique de chaque adhérent (production et gestion d'une carte d'identification)
  • Données professionnelles de l'adhérent
  • Régime d'assurance-maladie (catégorie tarifaire, plan de couverture)
  • Les personnes couvertes par le régime d'assurance-maladie avec identification unique de chaque ayant droit

- La gestion financière d'affiliation (les cotisations et les remboursements réalisés)
- Gestion des litiges liés à l'adhérent ou à un des ayants droits
— Identification des prestataires de soins et des structures sanitaires via les codes d'identification uniques.
— Données des plans de couverture: une OAM peut gérer un ou plusieurs plans d'assurance qu'elle offre à ses adhérents.
— Nomenclature des prestations de soins normalisée par le MSP.
— Tarification par rapport à la nomenclature des prestations de soins
— Données des remboursements réclamés et réalisés

    Au niveau des FOSA

— Gestion des adhérents et des ayants droit
- Données démographiques de l'ayant-droit et son statut avec identification unique de l'adhérent et/ou de l'ayant droit (utilisation de la carte d'identification)
- Régime d'assurance-maladie (catégorie tarifaire, plan de couverture)
— Nomenclature des prestations de soins normalisée par le MSP.
— Tarification par rapport à la nomenclature des prestations de soins
— Données des remboursements réclamés et réalisés (pour la comptabilité).

Au niveau du MSP

— Identification des prestataires de soins et des FOSA
— Nomenclature des prestations de soins: une liste normalisée des prestations de soins qui sont remboursables à utiliser comme référence par les prestataires de soins.
— Tarification par rapport à la nomenclature des prestations de soins.

3.5   Architecture technologique

L'architecture technologique d'un système de gestion des OAM aura les spécifications suivantes :

— Interface utilisateur basée sur le web
— Outils clients diversifiés : navigateur web, de préférence l'application sera compatible avec les dernières versions de Chrome, Firefox, Internet Explorer, Opera et Safari. Applications bureautiques standards pour la visualisation et l'analyse de données
— Protocole de communication réseau : http et https
— Base de données : relationnelle avec interface ip. L'application est de préférence indépendante du SGBD utilisé.
— Système d'exploitation : Linux ou Microsoft Windows
— Interfaces et API : RESTful, SOAP
— Développement : PHP ou Java, JavaScript

L'échange de données entre les applications sera basé sur des technologies 2G/3G dans des zones de couverture IP et par SMS ou USSD dans des zones à très faible bande passante.

Pour les antennes des MS et les points de collecte isolés, des versions réduites de solutions de gestion des données de l'assurance maladie pourraient être utilisées sur des tablettes, smartphones ou téléphones ordinaires.

3.6   Opportunités et solutions

Sur base de l'existant, des capacités techniques locales et de l'offre technologique dans la matière, nous avons pu identifier 2 solutions (MAS Gestion et OpenInsurance) qui rencontrent les besoins métiers définis pour la gestion de l'assurance maladie et qui sont déjà utilisées en Afrique.

Le logiciel MAS Gestion qui a été développé par l'équipe du programme STEP (Strategies and Tools against Social Exclusion and Poverty) du BIT (Bureau International du Travail) en Afrique et qui a été progressivement installé et utilisé dans un certain nombre de MS communautaires et leurs structures d'appui au Sénégal, Burkina Faso, Bénin et RDC [16]. Il permet à un système de micro-assurance santé

d'effectuer la gestion des adhésions, cotisations et prestations et de suivre mensuellement l'évolution de 13 indicateurs permanents dont la population couverte, les coûts moyens, les fréquences d'utilisation, ... ainsi que des indicateurs d'évaluation. Ce logiciel comporte également un module comptable simplifié.

Interface utilisateur	graphique
Outils clients	navigateur web, compatible avec Chrome, Firefox, Internet Explorer, Opera et Safari.
Protocoles de communication réseau	http, https
Base de données	Microsoft Access
Système d'exploitation server	Microsoft Windows
Système d'exploitation client	Microsoft Windows
Interfaces et API	MDAC
Développement	VB

Tableau 1 : La fiche technique de *Mas gestion*

Le logiciel OpenInsurance qui a été créé par la société burundaise Open-IT. Il est basé sur le Web et gère la grande majorité des informations qui circulent dans les OAM. OpenInsurance est basé sur des technologies open source et est librement disponible [17].

Interface utilisateur	Web
Outils clients	navigateur web, compatible avec Chrome, Firefox, Internet Explorer, Opera et Safari.
Protocoles de communication réseau	http, https
Base de données	MySQL
Système d'exploitation server	Linux, Microsoft Windows ou OS X
Système d'exploitation client	Linux, Microsoft Windows, Android ou OS X
Interfaces et API	RESTful
Développement	PHP ou Java, JavaScript

Tableau 2 : Fiche technique de *OpenInsurance*

3.7 Migration et planification

Une migration de l'architecture de départ vers l'architecture cible devra être minutieusement planifiée. Des priorités de mises en œuvre devront être définies. Actuellement des discussions sont en cours pour l'adoption d'un projet de loi portant sur la couverture universelle en soins de santé en RDC. D'autres priorités sont la mise en œuvre de la réforme hospitalière, l'adoption de la loi cadre sur la santé publique [18] et la réforme de l'administration publique avec un accent sur la rationalisation de fonctionnement des formations sanitaires.

Le Plan National de Développement de l'Informatique de Santé de la RDC devra également suivre sont cours d'adoption depuis la présentation du rapport technique le 20 Octobre 2014 [12]. Une architecture pour la gestion des informations des OAM s'inscrit dans le cadre de ce PNDIS et suivra le calendrier proposé de son implémentation. Avec le début de l'implémentation des SIH programmé par le PNDIS au courant de l'année 2015 [12], certaines composantes de ce système devront faire appel à des mécanismes d'assurance maladie comme le remboursement de soins de santé, la gestion des paquets de soins et des services, le monitorage de la qualité des services et autres.

3.8   Implémentation et gouvernance

Nous avons vu dans l'architecture applicative que l'application de gestion des assurances maladie devra interagir avec d'autres applications comme le SIH, les solutions de comptabilité générale et analytique, le SIG,… Il est conseillé que lors de l'implémentation des ces autres applications on tienne également compte des mécanismes de l'assurance maladie.

D'autres étapes préparatoires avant l'implémentation de l'informatisation des OAM concerneront la documentation de l'impact du PNDIS sur ce processus, des exigences stratégiques, l'anticipation des demandes de modification comme les interfaces, la chronologie et la feuille de route dans l'étude d'impact, le contrat de l'architecture,…

La gouvernance de la mise en œuvre du plan d'informatisation de l'assurance maladie sera étroitement liée à la gouvernance globale de l'architecture entreprise e-santé développée dans le PNDIS. Un aspect clé sera d'assurer le respect de l'architecture définie par les projets de mise en œuvre et par les projets en cours. Pour ce faire, le MSP devra se doter d'une expertise solide en matière de gestion de projet dans le domaine de l'informatique de santé.

4   Discussion

Dans cette étude nous avons analysé le rôle de l'informatique dans le développement des mécanismes d'assurance maladie en RDC et dans le suivi de la politique de couverture universelle en soins de santé prônée par l'OMS depuis 2005.La RDC a décidé depuis 2010 d'adopter une loi sur l'assurance maladie universelle en institutionnalisant une agence nationale d'assurance maladie (ANAM) et les mutuelles de santé (MS) des ZS. La loi est toujours en cours d'étude mais un programme national de promotion de mutuelles de santé (PNPMS) a été mis en place. Certaines expériences mutuellistes ont déjà été recensées même si la pénétration reste faible. Il s'est avéré tout de même que la gestion des MS et de l'assurance maladie au niveau central devra faire appel aux outils informatiques.

L'architecture métier de l'assurance maladie en RDC a expliqué les mécanismes de gestion des OAM comme définis par les auteurs Guy Carrin et Co. [7] et qui ont fait leurs preuves dans les pays africains comme le Cameroun [14], le Sénégal [19] et le Rwanda [3,20].

L'architecture applicative de la gestion de l'ANAM et des MS a décrit la gestion des adhésions, cotisations et prestations et le suivi de l'évolution d'un nombre d'indicateurs de performance.

L'architecture de données a démontré que le développement des OAM nécessitera la mise en place d'une gestion coordonnée d'un nombre de données en interne, chez les prestataires de soins et au niveau central du MSP. Une interaction et une communication entre les différents systèmes utilisés par les partenaires sera nécessaire.

Enfin les solutions informatiques de gestion et de communication devront être génériques, simples et robustes, de préférence basées sur le web et leurs codes sources seront de préférence libres afin de réduire les coûts récurrents.

Deux exemples de logiciels, MAS Gestion et OpenInsurance, développés pour l'Afrique [16,17] ont été proposés et comparés. L'implémentation de l'informatisation de l'ANAM et des MS devra suivre le PNDIS du MSP et s'inscrire dans la politique de la révolution de la modernité prôné par le Gouvernement de la RDC.

Conflits d'intérêt.
Aucun.

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Technology assimilation in community healthcare in the Western Cape, South Africa

Ralitsa D. Debrah [a]*, Sophie V. Bhebe [a], Retha de la Harpe [a], Ephias Ruhode [a], Doreen K.M. M'Rithaa [b], Vilma Vainikainen [c]

[a] Cape Peninsula University of Technology, Cape Town, South Africa*
[b] Stellenbosch University, Cape Town, South Africa
[c] School of Computing, University of Eastern Finland, Kuopio, Finland

Background and Purpose: Technology plays an important role in the lives of many in the 21st century of healthcare practice. It facilitates easy access to information, making it possible to connect with the rest of the digital world. However, not everyone in developing communities in Africa has equitable access to technology. This article aims at exploring possibilities of integrating technology into education and the work activities of the Home Based Community Healthcare Worker's (HBCHW's) in South Africa.

Methods: Participatory design method was used to obtain data by engaging with HBCHW's in Grabouw, Cape Town, South Africa. Data was obtained by engaging with 60 HBCHW's in a participatory design session. These sessions were organised at Elgin Learning Foundation (ELF) where the HBCHW's are trained. The participants were organised into groups of 10-20 per session at different times in order to obtain as many views as possible from the HBCHW's. Using the LACASA model as an analysis tool the information obtained was categorised to identify some possibilities that exist for technology integration.

Results: Data obtained, indicated opportunities for technology integration in the area of education and work activities of the HBCHW's. Some of the areas identified were in the treatment of patient, health education and promotion, training of HBCHW's, communication and recording of patient data.

Conclusions: Technology can potentially facilitate the training program at ELF and it has the potential in advancing teaching and learning of HBCHW's. Technology can possibly create avenues for easy access to education and information to empower HBCHW's in Grabouw towards sustainable community development.

Keywords: Technology, Community healthcare, Home based care

1   Introduction

Technology is gradually becoming one of the key elements to consider in facilitating community development. More and more organisations are building systems, platforms and many innovative ideas facilitated by technology to improve their service delivery. However, one of the areas which has seen a considerable growth in technology for service delivery is the healthcare system. In this sector, technology is used in areas such as recording patient data, recording and monitoring the health of patients, sending messages and feedback within the healthcare system and many more. Knowing the enormous benefits that technology brings to healthcare, it has become very crucial to find innovative ways of assimilating technology into the education and training of the Community Healthcare Workers (CHW's). This is very vital since they engage with patients in the community on the grass roots level, who are usually the majority who need more attention in healthcare.

However, not everyone, especially in developing communities in Africa, have equitable access to Information Communication Technology (ICT). In the absence of well-designed ICT driven solutions and less efficient interconnectivity, these communities are sometimes deprived of the benefits of ICT that could enable them to do their work efficiently and increase productivity within a reasonable time frame.

In an attempt to discover the opportunities for technology integration, the main questions that the researchers considered in order to achieve the aims of the study are: *How can the work of the HBCHW be facilitated by technology?* In addressing this question there was a need to know existing challenges in the education and work activities of Home Based Community Healthcare Workers (HBCHW's) in order to identify opportunities for technology assimilation. These were the few critical questions that guided the study which was mainly conducted with HBCHW's. It must be accentuated that the researchers did not focus on the technology integration to the other stakeholders involved in the healthcare service delivery system in Grabouw at this point, but rather from the perspective of the HBCHW's towards facilitating their work activities.

Therefore, in this paper the authors present the context of the Grabouw community and background to the study, methods used, how the community was approached and the findings that were obtained during the period of the study using the LACASA model as an analysis tool for the data obtained.

1.1   Background

Community Health Workers (CHW's) contribute enormously to the management and reduction of critical conditions of patients nearby as well as remote communities. They often deal with infectious diseases which sometimes need constant information to manage in order to improve the health of their patients in critical conditions. However, technology is perceived to be a valuable tool that could minimise the basic challenges they have with healthcare service delivery. The consideration of assimilating technology such as mhealth in their work activities and education as a way of empowering them by technology [1] requires the understanding of their context and the communities in which they work.

Communities are usually described as groups of people associated by a geographical location with a common interest and issues affecting their lives and well-being [2]. Researchers have indicated that "anything we do in a community requires us to be familiar with its people, its issues, and its history" [3]. In this case the Grabouw community is situated within the Western Cape in South Africa. Therefore it is necessary to understand the context of HBCHW's and also to identify their ICT capabilities, before considering possibilities of assimilating technology into their day-to-day activities.

1.2   Case Description: the context of Grabouw

Grabouw is an agri-commercial centre in the heart of the Elgin Valley, about 70 km from Cape Town along the Garden Route. This Valley is the agricultural service centre and hosts about 76 farms. It is the largest fruit production and export region in South Africa. Due to a poor socio-economic environment in the South African Development Community (SADC) and Africa in general, the little town of Grabouw, and all towns in the Overberg District, attract seasonal and informal labour from across the province and country. Some migrant labourers travel from as far North as Mozambique, Zimbabwe, and the Limpopo [4] to work in this community. Grabouw therefore carries the resultant burden of having to sustain the ever-growing migrant population. A myriad of socio-economic challenges face the farming community of Grabouw because the town is over-populated. Crime and violence, the HIV and AIDS scourge, substance abuse, teenage pregnancies, uncontrolled migration, lack of jobs, a growing ageing population, poor hygiene and inadequate health facilities are some of the challenges the community faces. Due to these challenges, the community study case has become of interest to the researchers in South Africa and other researchers across the globe.

The study is a collaborative partnership between Cape Peninsula University of Technology (CPUT) and Elgin Learning Foundation (ELF) in Cape Town, South Africa. The project is mainly focused on Information System for Development (ISD4D) to find possibilities of integrating technology into healthcare for community development. The international network, INDEHELA (Informatics Development for Health in Africa) is a longstanding network of various universities, for example, CPUT, University of Eastern Finland, Eduardo Mondlane University in Mozambique and, depending on project and funding, sometimes also Obafemi Awolowo University in Nigeria are active players in ISD4D projects.

Researchers from CPUT's INDEHELA-ISD4D group sought to engage the Grabouw community for the purposes of engendering social improvement through the appropriation of ICTs. Multi-layered interdisciplinary work with researchers from Information Technology (IT), anthropology, design, and journalism domains was carried out with the Grabouw community. The flagship research project which

the researchers co-designed with the community is the Home Based Health Care (HBHC) project. The next section briefly describes the (HBHC) provision to the Grabouw community.

1.3   Home based health care services

The HIV and AIDS' impact on community health influenced the South African Department of Health (DoH) to acknowledge the activities of HBCHW's in 1997 as a necessity to providing patient care within home and community settings. The DoH in collaboration with the Department of Higher Education and Training tasked the Health and Welfare Sector Education and Training Authority, to coordinate the training for HBCHW's with South African Qualifications Authority (SAQA) [5]. Entry requirements are a minimum education level of Grade 7. Training involves a 3 year program where learners obtain skills rated National Qualifications Framework (NQF) level 2 for the first year, level 3 during their second year, and level 4 in their third year. The training is conducted by the qualified registered nurses, with experience in primary health care. Through a tendering process, the DoH selects which NGO will manage patients who are on a HBHC program. The NGO is responsible for recruiting and training HBCHW's after getting permission from Government. The NGOs then sets up administrative centres where HBCHW's collect a list of activities to do and forms to fill out before they head into the field. On a daily basis, HBCHW's submit to the administrator the activities that they have done for the day. This information is collated and submitted to the DoH at the end of the month. It must be accentuated that it is the DoH, through a local hospital, that decides on which patients HBCHW's are to attend to, and what tasks they are to conduct. The NGO just acts as the go-between. The NGO also manages the payments of salaries released by the DoH to HBCHW's. The ELF has for over ten years been the implementing NGO for the HBCHW services provided in Grabouw. The following section (1.5) describes the concept of community engagement in the context of the ISD4D work with ELF and the Grabouw community.

1.4   Community Engagement

According to Centre for Disease Control (CDC), community engagement is "The process of working collaboratively with groups of people who are affiliated by geographic [or other forms of] proximity, special interests, or similar situations with respect to issues affecting their well-being. It often involves partnerships and coalitions that help mobilise resources and influence systems, change relationships among partners, and serve as catalysts for changing policies, programs, and practices [2]. Researchers are gradually realising that anything that they do in a community requires them to be familiar with the community's people, issues, and history. Figure 1 depicts the relationship involving the university (CPUT) and the Grabouw community. CPUT, as a learning and research institution, hosts a technology hub within the Faculty of Informatics and Design (FID). The technology hub's main agenda is to design and develop community-based IT projects. The hub falls within the ambit of the INDEHELA projects, whose researchers reach out to communities and engage participatory and co-design methodologies in information systems development. The Grabouw community, on the other hand, hosts several sub-communities of which NGOs are relevant stakeholders in the community.
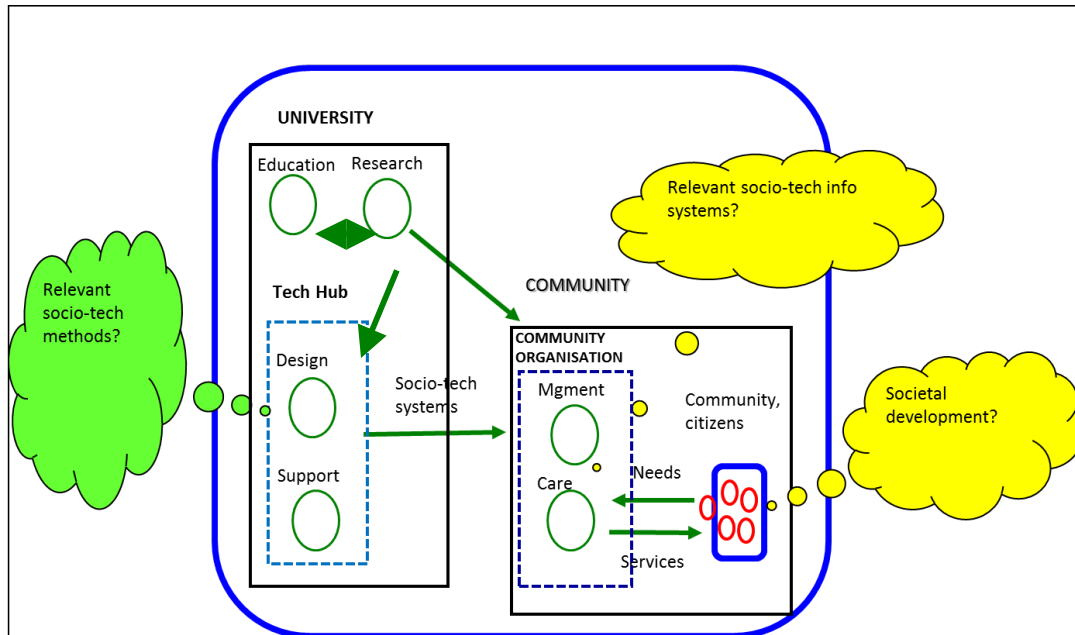
Figure 1. Relationship between the university and the community

ELF as an NGO and service provider facilitated the coming together of the community and the university's ISD4D project researchers. The researchers set out to know the Grabouw people – their culture, their concerns, and relationships – and also developed their own relationships with the community. This served as a foundation to understand the context of the community and what activities the HBCHW undertakes on a daily basis.

1.5   Technology in community healthcare

ICT has provided huge potential to support healthcare delivery and healthcare management globally. However, stories of technology that failed to live up to the promises in healthcare have been equally common [6]. That is unfortunately true especially in the case of developing countries or resource restricted areas. The healthcare service delivery systems are complex and composed of multiple levels of hierarchy and various vertical programs and processes. [7]. Furthermore, history, geography, culture, infrastructure, inadequate skill levels and pressures of everyday work further heighten the complexity of documenting and reporting of care whether supported by ICT or paper based [8].

1.6   Community informatics

In Community Informatics (CI), communities and community members are not seen as passive recipients of technological opportunities. People are seen as active actors in the perception and doing of problem solving towards change. The concern of CI is the relationship between people and technology. There might have been a lack of technological depth in CI approach in the past, because many researchers have come from humanistic and social work backgrounds. Many of the challenges CI deals with, could also be handled with IS discourse, yet IS approach may lack the depth of community focus. Stillman and Linger [9] suggest CI is a discipline agenda in which information systems problem solving approach is used to solve community problems. Gurstein [10] takes it further with multiple dimensions of CI which covers community development, social activism, policy studies, public administration, ICTs for development and service design. These areas also link to information systems management – all in all, a belief that this can be enhanced through the rational use of ICT and a sophisticated user-focused understanding of IT.

1.7   Community healthcare in South Africa

Home and Community-Based Care (HCBC) has emerged as a cost-effective and compassionate way to provide care to people in South Africa. Based on the findings of Health Systems Trust (HST) audit [11]

there were about 2000 HCBC organisations in South Africa in 2003. The number is growing steadily. HCBC organisations, however, face challenges such as lack of adequate funding and adequate infrastructure. This endangers effective service delivery but also reporting to funders. Lack of data available for decision-making might then further result in lack of funding. Approximately 20% of the audited HCBC organisations neither had access to electricity and water nor an office. Approximately 36% of the organisations reported having no computer equipment for their health service delivery documentation and reporting. Also, it was identified that there was a shortage of ICT in the healthcare service delivery of HCBC. For example, shortages recorded were indicated in the following localities as: KwaZulu-Natal 47%, Limpopo 30%, Northern Cape 60% and Eastern Cape 35%. Therefore due to this absence, submitting reports electronically were seen as a challenge, because even if there were computers, staff members were not always computer-literate, could not afford electricity or there was no internet access [11].

1.8   Technology driven initiatives

Technology driven initiatives such as mHealth, can improve communication and provide access to healthcare. As reported in The Pan-African mHealth Initiative South Africa, [12], mhealth presents opportunities to increase access, improve capacity and reduce costs of healthcare. The improvement of access to health information, diagnosis, better treatment and monitoring were seen as major drivers for mhealth. Further the report indicated that improving health capacity included providing more consistent education for healthcare workers while decreasing errors in data collection and health assessment. This was seen as being able to provide more direct access to healthcare expertise in areas with low or little health access.

Mhealth drivers were also viewed as being able to reduce the burden of costs to consumers who can minimise wasted trips to clinics and to the health system through patients managing their health better and through more efficient and accurate data collection [13]. Further the report indicated that out of the 83 mhealth services 18 focused on women and children and 42 on HIV / AIDS. Out of the 83 mhealth services 46 were led by NGOs while 17 were led by mobile operator Vodacom.

However, there are persistent challenges that come with the implementation of ICTs in healthcare. Some of these challenges as described in the South Africa mhealth Feasibility Report [12] include: Multiple mhealth services which have had problems reaching national scale due to lack of articulated tested standards for mhealth and the lack of business case at scale for commercial roll-out of mhealth services. Some of the opportunities for development included: Similarities in use cases, objectives across the different mhealth services, expertise and lessons learnt across the mhealth implementation value chain, commitment and interest from mobile operators as well as mhealth service providers for collaborative action.

Moving forward, the researchers in this study case considered the opportunities for development mentioned above, as a way of assimilating technology into the work activities of CHW's. Also, considering the lessons learnt, from the mhealth feasibility report, researchers used methodological approaches such as Participatory Design (PD) in order to engage HBCHW's in the design process of the technology intervention as much as possible to provide solutions tailored towards their needs.

2   Materials and methods

Participatory design methods were used by researchers in this study in order to include the users in the possible technology interventions that could be suggested. This approach is also a preference by ELF towards finding innovative technology solutions for human capital development and wealth creation for community development in Grabouw.
Through this approach, several visits were made to ELF and informal interviews were conducted with the staff members. However, it was noted that training and deployment of HBCHW's is the flagship program of ELF. This has resulted in ELF's interest and participation in the research being conducted towards improving the healthcare services provided by their organisation to the Grabouw community.
Further, researchers engaged HBCHW's in a PD workshop to understand what their needs are in the community and how technology can be implemented to facilitate their training programs and work activities. Informal interviews were conducted with the staff of ELF and the HBCHW's which provided an understanding of their administrative processes and insights into the work. The interviews were

conducted with 10 informants from both ELF administrative staff and HBCHW's in the Grabouw community. Interviews were conducted in focus group discussions with 7-10 members per session. However, in other instances the interviews were conducted on a one-to-one basis with informants at their own convenience.

2.1   Ethical considerations

Ethics consideration in any given research is very crucial to obtain the consent of the participants. This allows participants and researchers to gain confidence in each other and also in the research being undertaken. Here in this study, researchers ensured that participants gave their consent before any activity was undertaken. This was addressed by giving participants consent forms to fill in and indicate their interest in the study. It was, however, clearly stated in the forms and also articulated to them that they can withdraw, if they are not comfortable with the research activity at any point in time. It is worth noting that all the participants indicated their interest in the research work out of their own free will and, at this stage, researchers were ready to collect data relevant for the study.

2.2   Participatory design approach to data collection

User-centric design methods, such as PD, were used to facilitate the data collection process. Since this research is part of a service development project (which particularly aims at improving services) it was essential to involve the users in the design process of the service. Consequently, user involvement and engagement reduces challenges that could emerge in the development of the service at the implementation phase.

Through the interviews and understanding of work activities, it was understood that the relationship as indicated by human behaviours cannot be previewed and controlled but can only be "enabled" [14]. Since technology has the capacity to "enable" HBCHW's to enhance healthcare service delivery, the PD approach was a way of involving the user to identify the technology assimilation possibilities from the CHWs' perspective.

In achieving this, the authors utilised themes which have dominated the PD discussions over the years such as user involvement and co-operation, with the objective of involving the user as much as possible towards achieving the goals in the study [15]. PD involves gaining the trust of the community which is an integral part of the design process [16]. This way researchers immersed themselves in the community and followed closely what HBCHW's do daily, to understand their work practice. This helped in building trust between the researchers and the participants. The PD sessions were conducted in the work environment of the HBCHW's. The PD workshops were organised in four major sessions at different levels with a total of about 60 HBCHW's participating. Each session comprised of a minimum of 10 and a maximum of 25 participants. They worked in groups of a minimum of 4 and a maximum of 5 within each session. These were mainly conducted within a period of 3-4 hours per session with regular breaks per design activity. Materials used in the design activities were mainly basic materials (as indicated in table 1) which HBCHW's were familiar with and can easily handle. However, in this article, the data obtained from these sessions has been analysed using the LACASA tool which served as a model to organise the data with regard to the context of the research objectives.

Table 1. Tools and materials used during PD session

Materials	Equipment
Paper	Projector
Pen	Camera
Markers	Scissors
Manila cards	Utility knife
Bond sheets	Audio recorders

2.3   Analysing data using the LACASA TOOL

To analyse the research data, the **LACASA** which is a tool for context analysis, scanning the needs, strengths and constraints of the target host was adopted for the analysis. The initials stand for: **L**evels of **A**nalysis, **C**ategories of **A**nalysis, and **S**copes of **A**nalysis. The LACASA is based on three context maps,

which served as a foundation in mapping different aspects of the information system, and the actual tool is the LACASA question list and tables [17], [18], [19] . It is designed especially for studying information systems contexts of challenging areas, such as developing countries. The concept of context is huge and very difficult to define or explain, hence the framework of context analysis is aimed to be a tool to help understand the context. After Heeks [20], the successful IT projects are led by hybrids that span the technical and organisational systems. However, these hybrids are quite rare; thus, this framework offers a context map, which is aimed to help anyone to expand their hybrid viewpoint. The LACASA table would help to separate and divide different items in the IS context, to classify and divide different components/ items in the IS, for specialising what kind of expertise or resources are needed. For instance, if the item/ problem is on the socio-political category, it is not probable that it can be changed inside the organisation, but inside the organisation it is possible to innovate suitable strategies to adjust the situation, and even try to benefit from it. It is not an exact model which will generate answers automatically, but a tool to help to find the way. Based on this, the data obtained were then analysed using the LACASA tool, as indicated in Table 2, to explore the opportunities of assimilating technology into the work practice of the HBCHW's.

3 Results

Results presented here are mainly based on data obtained by researchers during informal interviews and the PD sessions organised with care givers in the ELF. The LACASA model was used here as a tool to analyse existing data obtained from the study as indicated in Table 2. The LACASA model was adopted with slight modifications (see Table 2-3) to suit the context of the study.

3.1 Analysing data using the LACASA-tables

The LACASA Model below is used as an analysis tool to understand the contextual environment of the work practice of HBCHW's. This is done in relation to the work activities, the NGO which does the employment and deployment, as well as the community in which HBCHW's resides and undertakes their work practices.

Table 2. LACASA analysis tool

Before Analysis Inside Analysis	1. What is wanted - Current situation (Scopes, Categories and Levels of Analysis)	
	HOST	GUEST
Scopes, Landscape: The organisation and its environment. Meaning (Raison d'être) of the organisation. Why does the organisation exist? What is its target? What is its relationship with the surrounding environment (cultural/ historical socio political)? Organisational ethics **Organisation:** Profit/non-profit Public/private Local/regional/national/ international, leadership questions	**Meaning:** HBCHW's provide palliative care and promote health wellness within communities. **Relationship:** HBCHW's live within the community; they are trained and employed by a local NGO. **Background:** Majority are women within the 35-49 years age group. Common language spoken is Afrikaans although training is conducted in English.	**Meaning:** The ELF is a Non-Governmental, non-profit Organisation (NGO) formed in 1995 to meet the needs of disadvantaged communities in South Africa. **Relationship:** The Elgin Community College (ECC) (Section 21 Company), an affiliate of ELF, is registered as a private FET college to offer accredited training. ECC is quality management through related Sector Education and Training Agencies (SETAS) within the National Qualifications Framework (NQF) of South Africa

Inside Analysis (HOST)	2 . Are the resources available?	3. What resources are needed?
Human Resources Purposeful Education/experience Motivation Work Ethics Management Experts Other Personnel	**Education/Experience :** **Pre:** Grade 7-10 Primary School Completion **Training:** Provided by NGO in collaboration with DoH and HWSETA under Department of Education. Training involves a 3 year program where learners obtain skills rated NQF level 2, 3, and 4. It is conducted by qualified Registered Nurses, who have worked in Public Health. Training is conducted in English over 1 week periods and learner then goes into the field and applies knowledge under supervision of Home Based Care (HBC) Co-ordinator and is Assessed by Trainers after a period of time. **Work Ethics:** Follow the work ethics that apply to health workers with respect to patients, people, community and organisations they will be working for. **Management:** HBCHW's are managed by a HBC Co-ordinator who is a qualified registered nurse and midwife, who is employed by the NGO managing the program. Weekly reports and stats are submitted to both the HBC Co-ordinator and NGO Assistant. **Work Structure:** Their work scope is within the following categories: Health promotion, Care for Aged, disabled, children, women's health, men's health, HIV/AIDS	mLearing Platform
Economy, Financial Resources	**Finances:** Currently they are paid a stipend by the contracted NGO which covers less than their basic needs. They are given clothes by the NGO with the brands that are appropriate for the current weather conditions. However, the stipend and clothing are often not suffient.	Bigger stipend Better working attire
Infrastructure, Technological Resources	**Technological Resources:** Basic Computer Skills Training is conducted as part of their core curricula. Included with this is training in Accounting and Payroll Systems. **Cellphones and Tablets:** Currently majority of HBCHW's are using low-end cellphones, which enable them to call and receive calls as well as SMS. They are aware of smartphones and tablets and the social media platforms that are hosted on them. **Data Storage:** As work environment is mainly pen and paper based, majority of the data stored is in files and drawers.	Transport to conduct work
Socio-Political Environment	**Challenges in communicating are**: Language barriers	

| Categories, Challenges: **Nature, Culture and History, Moment** | **Nature:** Fluctuating deciduous weather conditions. Extreme winters. Walking long distances. **History:** HBHC started in the 1950's as patient care was required for malaria patients, was officially recognised by the DoH in 1997 and work practice delineation set with the Department of Education and Training. **Moment:** There are an estimated 60000 to 70000 HBCHW's in South Africa providing care to communities. **Culture:** Farming community that relies on apple farming and this is seasonal affecting the job opportunities availability, giving rise to migrant workers. **Gender:** There are more females than males, due to there being more women breadwinners in the society. **Language:** According to Wiki 2011 [21] stats for Grabouw

 First languages (2011)[21]
 • Afrikaans   61.8%
 • Xhosa   28.5%
 • Sotho   5.0%
 • English   2.5%
 • Other   2.2% | **History:** The organisation, founded in 1995, is a legacy of the kind-hearted vision of a childless farming couple, Gerald and Hazel Wright, who left their entire estate to be dedicated to improving the lives of farm workers in the fruit farming industry. ELF has now blossomed into a social enterprise and an accredited FET College that employs in excess of 100 people at any one time. |
| Analysis Levels: **On which level of the context should the analysis be targeted?** | Education levels | In their work activities |

Table 3. Overview –table of the analysis

Element	Identified elements
Organisations	ELF
Key actors	HBCHW's, HBC Co-ordinator, HBC Assistant
Most important information systems, e.g. legacy systems (by name)	N/A
Information entities	Patient referral to and from Local Clinic and DoH with Co-ordinator as middle man Training done by contracting NGO Health Promotion materials with the community Patient palliative treatment and health recording with Patient and NGO
Main Work Activities / process steps	**Their work scope** is within the following categories: Health promotion, Care for Aged, disabled, children, women's health, men's health, HIV/AIDS. **Work Activities**: *Weekly Activities:* Daily Patient care, Set Days Patient visitations which do not require daily care, Health Promotion Day during the week.
Development points/ disharmony	**Present use of technology:** Challenges of being attacked by unfriendly people in the community.
Other issues important to picture	**Travelling:** Issues with transportation

3.2   Opportunities identified for technology integration

Through engaging with the HBCHW's, it was identified that several opportunities exist to integrate technology within the area of education and in their work activities. These cover some of the main activities that the HBCHW's are involved in, primarily with the stakeholders within the healthcare system in Grabouw. Through some of these services the researchers obtained information on areas where HBCHW's are actively involved. Some of them include:

- *Right to Care* - it is a service provider funded by DOH to do capacity building that consists of training and mentoring for HBCHW's, on health topics.
- *Themba Care* - rendering similar service to those of ELF but targeting HIV/AIDS patients.
- *DOH District Caledon* - responsible for conducting capacity building for HBCHW's, coordinators and care givers, particularly on changes with regard to regulations and other necessary information.
- *Day hospitals/Clinic* - primarily responsible to assist with referrals with regard to clients that need the HBC, where caregivers have to provide feedback to the clinic thereafter on a weekly basis.

Additionally, data obtained through interview sessions enabled researchers to identify the opportunities that technology can be used to facilitate the work of HBCHW's. These challenges obtained during these service delivery points and the opportunities for technology support systems are presented here in Table 3.

Table 4. Overview of the table for the results

Main Research Question: How can the work of the Home based carers be facilitated by technology? *Sub-research questions 1: What are the challenges they face with education and their work activities?* *Sub-research question 2: What are the opportunities for ICT in their education and work activities?*		
Challenges faced with work activities/education	**ICT opportunities with education**	**ICT opportunities in work activities**
Learning materials • Training materials are largely paper based (presently it has been digitised which is mainly PDF)*	• Training using mLearning • Improving digital literacy skills	**Communication** Contact:- • People in emergency • Coordinator • Other organisations • Colleagues • NGO • Patient • Coordinator
Record keeping • Paper based system for recording patient data	• Peer to peer learning	**Patient management** • Obtain information on medication • Capture patient data • Evaluate patient information
Media • Absence of digital platform for patient education and communication	• Obtaining learning materials online	**Health education and promotion** • (materials for health campaigns)
IT for treatment • Absence of wearable technologies for patient treatment and monitoring	• Obtain information for treatment on various diseases (high risk-low risk patients)	**Health services** • (Such as checking of blood pressure, sugar level etc.)

4   Discussion

Improving healthcare is of great importance in any given society. The efforts of CHW's in administering healthcare cannot be underestimated. Based on the statistics on the situational analysis of the healthcare service delivery in South Africa, it becomes evident that more CHW's need to be trained and deployed to remote areas. The implications are that their services can reduce the challenging situations with healthcare on the grassroots level common in many parts of Africa. As indicated in the earlier parts of this article, the study focuses on the Grabouw community where the education and the work activities of the HBCHW's were studied.

Using the LACASA as analysis tool, it was identified that there were many challenges that exist with technology in the work of HBCHW's. The findings in this study revealed the persisting challenges with existing ICTs as well the absence of adequate technology assimilation in the daily activities of HBCHW's. Many ICT related opportunities were identified in this study, there were more pressing needs such as the issues with infrastructure, transportation, stipend, protective clothing, training and security which were passionately articulated by HBCHW's.

These are the most essential needs as mentioned by CHW's which also correlates with the findings indicated in the South African mHealth survey regarding CHW's in Africa [1]. Thus, it can be authenticated that these scenarios and challenges of the CHW's present opportunities for interdisciplinary researchers to investigate and also consider exploring design thinking strategies towards finding sustainable solutions for community development.

5   Conclusions

Community care givers play an important role in the healthcare service delivery in the South Africa. They undertake door-to-door service to reach patients in their homes. The findings in this study opened avenues where there are challenges, particularly in their work activities and education of HBCHW's. Therefore it is clear that there are opportunities where technology can be assimilated into HCBC services. Using ICT to support training programs in ELF has great potential to advance teaching and learning of HBCHW's in Grabouw.

Learners could advance their ICT literacy skills to improve healthcare service delivery in the community. Also, the provision of information and applications on digital devices such as instructional materials and electronic patient record systems for HBCHW's on mobile platforms could make their work easier and efficient. Additionally, ICTs can potentially create avenues for easy access to education and information to empower HBCHW's in Grabouw towards a sustainable community development. It must be stated that although this has been presented based on the studies conducted, further studies can be undertaken to identify other key areas where technology can be assimilated into HCBC services. Also, future studies can be undertaken into informatics education of HBCHW's in order to meet the demands of the global digital age of healthcare service delivery.

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Peer based reviews as a strategy for strengthening the health information systems: a case study from Malawi

Christon Moyo [a],*, Tiwonge Manda [a], Petter Nielsen [a]

[a] Department of Informatics, University of Oslo, Oslo, Norway

Background and Purpose: Many developing countries are implementing strategies to address the challenges of health management information systems in terms of low data quality and limited data use in decision making. Limited data use is both a cause and a result of poor data quality, a vicious circle that is hard to break. This paper investigates the potential in a peer based review strategy to break this vicious circle and contribute to strengthening health information systems (HIS).

Methods: This is a case study based on implementation of quarterly zonal reviews in Malawi aimed at strengthening HIS. Data were collected through participant observations, semi structured interviews, focus group discussions, field notes and official documents.

Results: The peer based reviews provided an opportunity for skills development of health workers, establishment of learning networks to improve coordination and collaboration among stakeholders and improved data quality and promotion of its use in decision making processes. One of the challenges was inadequate preparations of the districts teams due to lack of facilitators at district level. In addition, some peers were not comfortable to review the work of their colleagues.

Conclusions: Peer based reviews can contribute to strengthening HIS in developing countries through promoting learning networks, data quality checks, data use, and enhancing collaboration among managers. The intervention has the potential to break the vicious circle of poor data quality and limited data use and thus contribute to strengthening the health information systems. Further research areas are considered for enhancing the practice at the district level.

Keywords: Peer based review, health information systems, learning networks, skills development

1   Introduction

Health information systems (HIS) have been designed and implemented to provide information for use to inform programme planning and decision making [12, 24]. However, there are many challenges preventing HIS from effectively providing such data. One of the challenges is the limited use of data for decision making, resulting in low data quality in terms of completeness and timeliness. When HIS produce low quality data, it is not used in programme and policy development, planning and advocacy. Poor data use is both a cause and a result of poor data quality and results in a vicious circle that is hard to break.

Various strategies have been explored to strengthen HIS [16,3]. Most of these interventions have, however, focused on addressing technical aspects such as changing the system design or revamping the technology used, to improve data quality and availability. This approach has overlooked the behavioral or organizational issues which are equally critical in the efforts to strengthening HIS. This paper describes how peer based reviews, through the establishment of learning networks and skills development, can contribute to improving data quality and use for decision making. Learning networks are groups of people who share a common concern or a set of problems and who intend to deepen their knowledge and expertise in an area [29]. The paper aims at offering practical guidelines for policy makers in their efforts to strengthen HIS. Specifically, the paper focuses on the following questions:

1. How can peer based review processes contribute to improve data quality and data use?
2. How can learning networks be strengthened within the context of the Malawi health system?

In order to answer these questions, a case study from Malawi forms the basis for the analysis.

Peer based reviews.

The concept of peer based review has a multiplicity of definitions and functions and is applied in a variety of fields and studies [14,21,4,22,27,10]. Some studies have defined it as evaluation conducted by colleagues working together in a practice aimed at achieving continuous improvement [14]. In other studies, peer based reviews aim at maintaining and enhancing quality [22] or providing collaborative feedback, exchange of experiences, and joint problem solving [21,14].

This paper takes a broader view on peer based reviews; as a process undertaken by a group aimed at assessing each other's work, exchanging experiences, solving practical problems and enhancing collaboration with a view to improve data quality and use for decision making. Peer review is, therefore, seen as an evaluation by peers working together in a practice aimed at achieving continuous improvement [14]. The approach provides a platform among peers to foster learning, delivery of feedback on work, and shared understanding of challenges. The process is in line with the work drawn from studies on building and promoting learning networks [10].

In the health sector, different peer review models have been used for improving clinical performance, internal quality of care, and in standard setting [14]. Braa et. al. [4] have discussed peer review process in improving data quality and use in Zanzibar. Srinivasan [27] studied how primary health care performance data use at monthly review meetings of peers improved not only health workers' motivation and performance, but also their skills and professionalism in Maharashtra in India. Despite a multiplicity of models, peer based reviews are described with common characteristics: skills development, building collaborative learning among peers [8], exchange of experiences and problem solving [14].

Learning approaches.

Different learning approaches have been used in providing opportunities for enhanced interaction between the facilitator and the learner: traditional face to face learning, peer based learning, communities of practice, and networks of learning. The traditional face to face learning model is centered on the facilitator [11,12], and typically based on teaching in a classroom setting [9]. The teacher or trainer passes on the information to the student or trainee. However, this approach can be ineffective in a number of ways. Training typically takes place within a short term period and there are inadequate follow up mechanisms. In addition, there are skill and knowledge asymmetries between facilitators and learners [12]. Consequently, peer based learning has been proposed to address these shortfalls. With peer based learning, members with similar roles provide guidance and assistance, and sharing of understanding of common challenges in a symmetrical fashion. While the model is also a form of face to face approach to learning, it   brings in an aspect of collaborative learning [8]. The process combines learning from the facilitator but also focuses on peer feedback.

A large body of literature also exists elaborating the concept of Community of Practice (CoP) [28,29,1]. A community of practice has been defined as a group of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in a particular area [29]. CoPs are important forums for learning and negotiation [28]; they show modes of belonging including engagement and alignment [1]; and foster ties to share knowledge and solve problems [9]. CoP consists of three main dimensions: domain of common interest or need, community for building relationships, and learning and practicing what is learnt [28,29,10].

The learning networks model provides an opportunity for enhancing interaction between peers. The concept of learning networks is basically about individuals and organizations working around a common concern [10]. Learning networks are aimed at building relationships, knowledge and experience and learning from each other [10,29]. Peer based reviews are in line with the learning networks model principles. The next section describes the materials and methods on which the paper is based. Following this, the empirical case is described. The results are followed by the discussion and lessons learnt.

2   Materials and methods

Empirical data for this paper has been drawn from participant observations during the implementation of Health management information system (HMIS) quarterly zonal reviews in Malawi, aimed at strengthening data quality checks and use. Data were collected between 2005 and 2012. The first author was involved as a participant observer and has been connected with implementation of HMIS in Malawi for more than ten years, facilitating the planning and implementation of the peer based HMIS review processes at sub national level. The other authors have been involved with the HMIS in Malawi to varying degrees, but were mainly involved in data analysis for this paper. Empirical data were collected through observations, semi structured interviews, focus group discussions, field notes and official documents. In total, 39 interviews were conducted during the period including district health officers (7), zonal monitoring and evaluation officers (4), assistant statisticians (9), district programme managers of the Malaria programme, expanded programme of immunization, maternal and child health and integrated disease and surveillance and response (19). Interviews were used to explore interviewees' experiences from participating in peer review processes. Further analysis of official documents such as health information system policies and strategies, review guidelines, quarterly review reports was done in order to contribute to the interpretation and significance of the reviews.

3   Findings/Results

3.1   Empirical case

The Malawi Ministry of Health has established an integrated, comprehensive and decentralized routine HMIS. The system is mostly based on pen and paper at health facility level and is computerized at district and national levels using DHIS, software for data collection, analysis, and presentation and reporting. The system has been implemented in all the 28 districts and 4 central hospitals since January 2002. There are 5 health zones and each zone has between 5-7 districts. The HIS is facing a number of challenges including low data quality in terms of completeness, correctness, consistency and timeliness. And there is limited use of data to guide decision making. Districts and facilities continue to submit delayed and incomplete reports. In order to address these challenges, the Ministry of Health established regular HMIS quarterly review meetings at zonal level as one of the strategies for strengthening HIS. The results in each phase are described below.

3.2   The Pilot Phase (2005)

In November 2005, the Ministry of Health in collaboration with the Zonal Health Support Office organized the first quarterly peer based review meeting for HMIS at a sub national level, the South East Zone. This zone was selected because it was the only zone out of the five that was fully functional at that time. The two day review meeting was held in Zomba district and the overall objective was to improve accuracy, completeness and timeliness of HMIS data. Specific objectives were, among others, to: validate data collected and compiled by the districts and health facilities and provide appropriate feedback to the districts; increase the capacity and skills of district HMIS officers and other stakeholders (including central hospital staff) to analyze, present, and use data; provide opportunity for sharing experiences and lessons learnt and identifying implementable solutions and obtain suggestions on how the HMIS could be improved; and provide a learning opportunity for future zonal review meetings.

The review covered the following agenda: Presentations from Ministry of Health headquarters on inter-district comparisons on selected indicators; presentations from the districts focusing on selected key indicators; group exercises for review of registers and data where one group from a district reviewed the registers belonging to another district with a view to identify gaps, problems and discrepancies. This was followed by the development of action plans. The review drew participants from district health offices and district assemblies from the health zone. Each district team comprised of the District Health Officer or his representative, the District Nursing Officer, the Assistant Statistician/HMIS officer and a representative of the District Assembly. Facilitators were drawn from various stakeholders including the

Ministry of Health (Health Management Information Unit), Health Programmes, Management Sciences for Health (MSH), Christian Health Association of Malawi (CHAM) and two zonal health offices.

Some of the major issues discussed during the review included, among others, the variability on the way the districts present data. Some districts focused on the indicators identified in the guidelines for the review, others tried to present as much data as possible from their respective districts. While some districts used graphs and charts to good effect, others did not resort to graphical presentations or used them inaccurately. The majority of the districts lacked data interpretation skills. During group work, districts peer reviewed the data collection tools and the data from other districts. This involved a review of a sample of HMIS registers from two selected facilities within each district (one hospital and one health center). The aim of the exercise was to identify gaps, problems, and discrepancies and make recommendations on the way forward. The role of the pilot was to test the methodology of conducting the reviews; refine the objectives; prepare the facilitators in conducting such reviews, as it was the first time the Ministry of Health was doing it at the sub national level.

3.3   The roll out Phase (2006-2008)

Following the pilot, the Ministry of Health decided to scale the review process by rolling out to all the five zones. Each quarterly review focused on a particular theme that was selected by the Ministry headquarters in consultation with the zonal offices.

3.2.1 Peer review preparations

Initially, district teams attending zonal peer reviews were not well prepared. District health information officers prepared presentations which were not shared with members of the district team. Some of the members were not even aware of their district data to be presented at the review meetings. Furthermore, the type, style and content of the presentations were not in line with the guidelines for preparation of review meetings, as provided by the Ministry of Health headquarters. During one review meeting, some districts were reportedly preparing their presentations during the meeting. All this contributed to lack of effective participation in the review process.

3.2.2 Development and implementation action plans

At the end of the reviews, districts prepared and discussed in plenary their respective action plans for implementation in the following quarter, to address identified gaps. The district action plans were then consolidated into a zonal action plan. The action plans identified HIS, and management and programme related issues/problems, including responsible entity for implementation and timeframe. The identification of issues for improving data quality and its utilization and the development of district and zonal action plans were the major outcomes of these review meetings. The Health Management Information Unit at Ministry of Health headquarters liaised and coordinated with concerned national and zonal players to ensure that action points were implemented and reported on at the subsequent quarterly zonal review meeting.

3.4   Maturity and Consolidation Phase (2009-2012)

Earlier phases of the HMIS review process emphasized improving data collection to ensure completeness and accuracy. The maturity and consolidation phase focused on data processing and presentation and consolidated what had been learnt in the previous phases. The staff from headquarters provided facilitation to the zonal office in order to build capacity at that level. Subsequent facilitation was done by the zonal office with headquarters taking the back stage. Additional facilitators from the central level (including programme officers) were invited to participate in the reviews as per thematic need, relating to each particular meeting. The involvement of the programme coordinators and partners was not only necessary to secure buy-in, but also to provide technical inputs into the review process.

Various processes were going on in the three areas of networking, practice and skills development. The review meetings brought together health workers from different organizations with a common purpose of strengthening health information systems. A number of practices were introduced including the use of different thematic areas for each review; face to face meetings of peers; use of different methods during

review process such as presentations, discussions and group work; peer review of data collection tools (registers) and data; sharing of experiences; and development of action plans. In the area of skills development, participants gained knowledge and acquired skills in presentation, analysis and coordination and action plan development.

On the other hand, a number of challenges were encountered during the review process. For instance, one challenge was that the peers were not comfortable to question their colleagues work. However this was addressed by ensuring the availability and use of facilitators with good facilitation skills.

4   Discussion

The Malawi Ministry of Health has conducted peer based reviews at sub national (zonal) level since 2005. The implementation of peer based reviews has had impacts in a number of areas. It has led to the development of different skills necessary for improving data quality and use. The reviews have also established networks for learning and sharing of experiences and strengthening collaboration with partners. The table below summarizes the key actions undertaken during the peer based review processes and the effects on strengthening the health information system.

Area	Actions	Effects
Peer based review as skills development	-Peer reviewed data collection tools and data -Analyzed and presented data -Developed district and zonal action plans -Zonal offices coordinated the reviews processes	-Participants (district teams) acquired analytical skills -Participants (district teams) acquired presentation skills -Participants (district teams) skills in development of district and zonal action plans improved - Coordination skills for facilitators from the zones improved -Data quality and information use improved
Peer based review as community of practice	-Joint problem solving -Use of different methods (presentations, discussions, group work) -Development of district and zonal action plans	-Learning networks among stakeholders established -Sharing of experiences and lessons learnt among participants (district teams, zonal officers, partners, non-governmental organizations),
Peer based review as problem solving	-Problem identification and suggestion solutions Development of district and zonal action plans	-Problem solving capabilities of participants (district teams) improved
Peer based review as evaluation	-Presentation on progress on implementation of previous action plans -Performance evaluating among districts -Providing feedback on the district data	-Performance improvement -Action plans served as monitoring tools during follow up processes
Peer based review as collaborative practice	-Participation of district teams, development partners and non-governmental organization -Use of different thematic area for each review	-Co-operative practice among health workers from various backgrounds -Stakeholders (Ministry of Health departments and programmes, partners, non-governmental organizations) buy-in and support the implementation of zonal strategies

The following lessons should be relevant in other developing countries based on implementation of peer based reviews for improving data quality and data use within the context of the Malawi health system:

1. Adoption of an incremental approach in implementing the peer based reviews. The use of a phased approach has assisted in consolidation the gains from each phase.
2. Institutionalizing the peer based reviews at all levels. There is need to strengthen the district level peer based review processes by ensuring the availability and use of trained district level officers who could facilitate district reviews. Related to that, a decentralized implementation of the peer based strategy should be accompanied by improved coordination and collaboration skills at that level.
3. Involvement of different partners and stakeholders in order to gain buy-in and support the initiative.
4. The development of concrete output of the reviews in terms of practical and implementable district and zonal action plans has strengthened monitoring aspects of the activities at district level.
5. Peer based reviews can be seen as a vehicle for skills transfer from one level to the other. Coordination skills being transferred from the national level to the sub national levels through peer based reviews.

Future research in this area should consider enhancing the practice at district level; use of technology to compensate for shortage in skills through auto generation of reports (can have different levels of skill across different levels - cascading); use of technology to promote online collaboration, considering that travel can be costly, but social media solutions have now gained ground.

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Towards problem-based health informatics education and research: ten years of experience and future directions in Ethiopia

Binyam Tilahun[a,b],*, Atinkut Zeleke[a], Fleur Fritz[b], Mihretu Mola[a], Mulusew Andualem[a], Solomon Assefa[a], Tesfahun Melese[a] ,Desalegn Zegeye[a], Abebaw Gebeyehu[c], Sisay Yifru[d]

[a] Department of Health Informatics, University of Gondar, Ethiopia
[b] Institute of Medical Informatics, University of Münster, Germany
[c] Director, Institute of Public Health, University of Gondar, Ethiopia
[d] Dean,College of Medicine and Health Sciences, University of Gondar, Ethiopia

Background and purpose: For successful implementation projects of health information systems, it is evident that a skilled workforce is needed. The department of health informatics at the University of Gondar in Ethiopia is the only health informatics teaching and research institution in Ethiopia. The department teaches health informatics at bachelors and masters level and conducts research in the area of health information system implementation and evaluation. In 2014, the department celebrated a decade of its services with different stakeholders to evaluate its contribution and to identify priority areas in the future activities of the department. The purpose of this paper is to share our ten-year's experience and future plans of the department in terms of education and research in the country.

Methods: The methods we used for this paper is analysis of presentations and follow up discussions from a two-day ten year celebration event. We summarize the participant's presentations and discussions from different stakeholders.

Results: The department graduates more than 50 students at the master level and is currently teaching 57 students at the bachelor level. Additionally, the department conducts many research projects in the area of health information system implementations and telemedicine projects in Ethiopia. During the two day workshop, the curriculum and graduate profile of the students was compared with the national eHealth strategy to make sure that the need of the country is in line with the curriculum. The eHealth strategy identifies five main areas of priorities for health information system implementations and the curriculum contains 62 ECTS courses directly related to each of the areas. The academic and research direction of the department was discussed with the need of the country.

Conclusions: The department is contributing to the achievement of the Ethiopian health sector development plan through its graduates and problem oriented research projects. This workshop helped the department to set its future objective in line with the country's need.

Keywords: Health informatics education, Ethiopia, Developing country, Problem-based learning

1   Introduction

The use of Information and communication technology in the health sector is rapidly expanding in Africa through different governmental and non-governmental eHealth initiatives. However, the size and skill of the workforce have not kept the pace [1]. Particularly in Ethiopia, electronic medical record, telemedicine and mobile health initiatives supported by the ministry of health and different non-governmental organizations, are being implemented to achieve the millennium development goals. Among many hindering factors-lack of capable, motivated and supportive professionals is reported as the main bottleneck [2, 3]. To alleviate this challenge, the University of Gondar established an independent health informatics department, which is the first of its kind so far in Ethiopia. The University of Gondar is one of the biggest and oldest among the 33 universities in Ethiopia. It was established in 1954 at the Gondar town, 715 km North West of Addis Ababa. Currently the university teaches more than 30, 000 students and it is also celebrating its 60 years anniversary of teaching, research and community service for the

country. The university is also well known for its medical education and community service through its specialized referral teaching hospital, which serves a catchment area of more than 5 million people.

The Department of Health informatics was established in 2004 initially for the purpose of supporting the hospital through ICT. But within those ten years the department has grown up to be an independent academic and research center of health informatics for the country. The department supported the efforts of the ministry of health through research and educating professionals at a bachelor and masters level for the last 10 years. In 2014, the department celebrates its decade of service through different events. The purpose of the anniversary was to discuss the department's contribution, the challenges and its future direction with the ministry of health and different stakeholders. The aim of this paper is to share our 10-year anniversary experience and our future plans to the HELINA health informatics community.

2   Materials and methods

The anniversary was conducted on March 3 and 4, 2014   as part of the University of Gondar 60th year Diamond Jubilee celebration with delegates from Ministry of health, University of Gondar officials, guest from Germany and the department's academic staffs. Additionally, a two-day follow up seminar was conducted. Our method for this paper is analysis of expert presentations and follows up discussions from a two-day celebration event. Discussions and agreed propositions to the department's academic and research future plan were summarized.

For the bachelor and master's program, Analysis of the curriculum with regard to the latest development of the field was done. The curriculums were analyzed with the recommendation of international medical informatics association [4].For the analysis of eHealth strategy alignment with the curriculum, we performed a comparative document analysis. We reviewed the draft eHealth strategy of Ethiopia [5] and the bachelors in health informatics curriculum of the University of Gondar [6].

3   Results

3.1   Academic outcome

The department is teaching health informatics program at bachelors and master's degree level as well as common health informatics course to medical and health science students of the college. The programs are explained below.

3.1.1. Bachelors Program.

The bachelor in health informatics program is the only program in Ethiopia as well even in East Africa. During the anniversary, the curriculum was reviewed and the course contents were analyzed. The program is a 4 years comprehensive health informatics bachelor's program curriculum which was developed by taking the local context and stakeholder needs as primary priority. The program was commenced in October 2012 by enrolling 26 students, and currently we have a total of 57 students. The contents of the curriculum and the practical and lecture lessons were assessed by the attending experts year by year and arrived to a consensus that it is in line with the country need and latest development of the field. Generally, the curriculum content was in line with benchmarked programs and IMIA recommendation. The curriculum content and the outcome are published in a separate study [6].

3.1.2. Masters Program.

The master's program is one of the success story for the department. Initially, it was started by the funding from university of Oslo. After five years, when the funding was over in 2012, the department was able to handover the program successfully. Generally the curriculum has total of 35 credit hours in operation since 2007/2008 sandwich course delivery methods. The program consists of public health oriented health informatics competencies. Most of the thesis research completed focused on assessing the data management activities of the health sectors using cross-sectional study design.

All the graduates are working institutions such as higher education, research centres, and plan and program offices in the health sectors. After the discussion, there was a consensus that the curriculum needs revision and to make it in line with the country need and to make sure that the graduates has good working opportunity. The curriculum content and the detail of the program is explained in another submission [7].

3.2   Academic profile of staffs

The department has currently 17 full time academic staffs that are teaching and doing research in the area of health information systems, electronic health records, system development, telemedicine and mobile health. It was also reported that different interested professors are invited for course delivery from different part of Ethiopia and other foreign countries. The detail information of the student (figure 1 and 2), staff and graduate profile (figure 3) of the enrollment information (figure 4) is shown in the following chart.
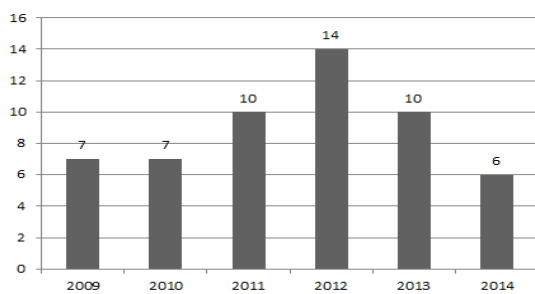
Figure 1. Number of graduates of our master's in Health informatics program from 2009- 2010
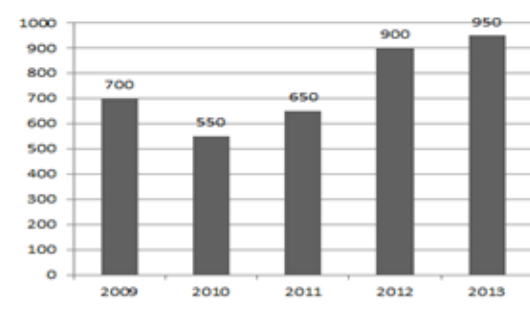
Figure 2. Number of health and medical students who take Health informatics courses
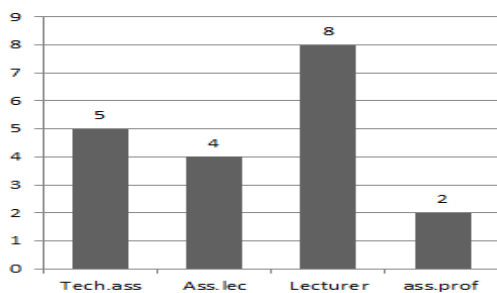
Figure 3. Current staff profile in the department (2013)
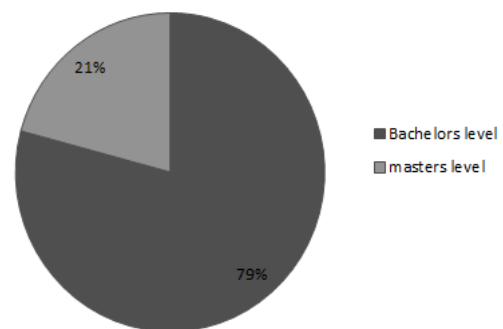
Figure 1. Current proportion of enrolment In the department 2013

A dignitary from the Ministry of Health presented the new eHealth strategy of Ethiopia and its implications for academia as well as the ministries expectations from the department and its graduates. In the presentation, the rationale of the eHealth strategy, current implementation focus areas of the country,

the status of different infrastructures for the success of eHealth, current implementation, guiding principles for eHealth implementation monitoring and evaluation methods and type of skills expected for the eHealth implementation were presented.

The eHealth strategy identified health information system, telemedicine, mobile health, eLearning and community information system areas as the main priority system applications to be implemented in the country. To respond to those competencies needs the curriculum has11 main courses with a total credit of 62 ECTS. Additionally, the curriculum contains 89 ECTS for strategic and communication level skills, 108 ECTS for technical level skills, and 50 ECTS courses for monitoring and evaluation level skills. The detail of the assessment and the evaluation is reported in another paper[8].

3.3   Ten year research outcome and future direction

In the research seminar, current research projects and publications were presented by the department and discussed with all the participants. To make the research of the department more focused and manageable, the department members proposed and agreed to form research groups. The formation of the research group was based on interest and expertise. With after seminar analysis of current staff's expertise and interests, two research groups in data management and eHealth Applications were formed.

The data management research group is intended to perform problem-based research in the area of data management in health and applications including EMR, HMIS, data quality and other issues of health informatics whereas the eHealth applications research group will conduct researches in the area of Telemedicine and mobile health. It includes both development and evaluation of already implemented projects. The formation of this research group will help the department to do more focused and dedicated researches. The participants form ministry of health also supports two of the areas as there are many related projects being on pilot by the ministry in the county. Participants of the ten-year research meeting are shown in the following picture (Picture 1).

Picture 1: Participants of 10 years Anniversary of Department of health informatics from March 3-4, 2014

4   Discussion and Future Perspective

The need for health informatics education is recognized by many countries. Kouematchoua et.al [9] discussed the need of health informatics curricula and ways to keep its sustainability in Africa. Continuous evaluation of programs and discussions with stakeholders are main issues to ensure sustainability and work opportunities for graduates. The two-day workshop and follow up discussions were good opportunity to promote health informatics education and to evaluate our work with regard to the ministries expectation and strategy.

With the review, the eHealth strategy of Ethiopia and the bachelor health informatics education at the University of Gondar were found in alignment to cover the skill and expertise needs for effective implementation of eHealth programs in Ethiopia. However, the department of health informatics and the Ministry of Health need to work together so that the students get practical experiences of all the courses during their study period. The curriculum was compared to the international standards and we found out that the bachelors program is in line with the IMIA recommendation but the master's program needs amendments in its course content and credit hours (ECTS) allocations. It was recommended that the department need to include amendments both to the masters and bachelor's programs.

Overall, the department's academic and research contribution; the challenges and the future direction of the department were discussed. The main challenges mentioned were lack of senior staffs, lack of budget especially for research and the minimal participation of the department in national eHealth projects. In the discussion, the university officials and the ministry promised to give more attention to the department activities.

In the concluding remark, the department future plan is to be center of excellence in health informatics education and research, to reactivate and strengthen the health informatics association of Ethiopia and to work closely with ministry of health and HELINA. MOH and University of Gondar officials pledged to support the efforts of the department and to involve and consult the department in the different eHealth projects under the ministry. To keep pace with emerging trends in information technology and health care services and its organization, we will keep updating our bachelor and master program. Additionally we will focus to cooperate with the different institutions for research and academic expertise exchange.

5   Conclusion

The department is contributing to the achievement of the health sector plan through its graduates and problem oriented research projects. In the anniversary workshop; the department's research and teaching contribution, challenges and achievements were discussed and future directions to make health informatics education in line with the country need was set and the department envisions to be center of excellence in health informatics education and research in Ethiopia.

Statement on conflicts of interest

There is no conflict of interest

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Considerations for the design of relevant health informatics courses for the African context: introducing informatics for nurses

[a] Sophie V Bhebe, [a] Retha dela Harpe, [b] Doreen KM M'Rithaa, [c] Kaija Saranto, [a]Ephias Ruhode

[a] Cape Peninsula University of Technology, Cape Town, South Africa*
[b] Stellenbosch University, Cape Town, South Africa
[c] School of Computing, University of Eastern Finland, Kuopio, Finland

Background and Purpose: While many Health Care ICT interventions have been developed, it appears that most are not being optimally utilised by nurses for their work practise. Lack of Informatics knowledge by nurses dealing with these systems and conversely lack of Nursing Informatics by ICT practitioners seems to be a major drawback in the design, development and implementation of such systems. Training of nurses and ICT practitioners requires designing Health Informatics Education programmes applicable to African contexts. The purpose of study was to raise awareness of the unique aspects of nursing informatics education and capacity building in South Africa ; share and discuss local needs and challenges; through facilitated group activities to help define specific educational solutions;

Methods: Two workshops facilitated by Nursing Informatics Educators from Finland and Cape Peninsula University of Technology were conducted. Nursing Education Stakeholders within the Western Cape were invited to attend. An inductive analysis was conducted using the following service design methods: questionnaires, participatory/co-Design and observation.

Results: Several Focus Areas, Needs, Challenges, Opportunities and Potential competencies were identified as necessary for implementation in order to develop Nursing Informatics Education Programmes;

Conclusions: The need to introduce relevant competencies in nursing courses is established with several international sources available to guide the process. However, the need in Africa requires education relevant to the African context. Educational advocacy to promote nursing informatics as a subfield of nursing education is necessary before designing relevant courses. Plans should include capacity development for educators who can teach these courses.

Keywords: Informatics, Nursing Informatics, Health Education, Health Informatics, Competencies, Education

1   Introduction

The burden of disease is more evident in resource-restricted settings that are in most cases serviced by less healthcare professionals than in developed contexts [1].Information and communication technologies (ICT) have the potential to facilitate better healthcare service provision [2,3]. However insufficient resources and digital level of literacy disparities between developed and developing contexts correlate with the restrictions encountered in development of appropriate ICT solutions [2, 4, 5, 6] for developing contexts. Introducing ICT into the healthcare services without considering the role of informatics in health education may be short sighted [2, 4, 6] when considering the development of relevant, resilient, and sustainable Health ICT innovations.

1.1   Nursing Informatics

Informatics involves the study of a combination of domain knowledge from the computer sciences with insights from information sciences7Informatics pedagogy in health constructs a multi-disciplinary speciality that involves segments of information, computer, and health sciences [7]. Informatics education

for nurses (nursing informatics) articulates to nurses these segments in terms they can relate to for them to have a holistic view of the role of Informatics within their profession. According to Staggers and Thompson8, definitions of Nursing Informatics can be amalgamated into three main categories, information technology, conceptual and role each with the nurse practitioner as main actor. Information technology looks at the use of nursing informatics skills   in enabling the nurse practitioner to conduct her clinical processes. Conceptual role advocates that nursing informatics competencies should be critically reflective such that it enables "proactive rather than reactive"9 elucidations within the nursing practise. Role definitions explore the relevancy of Nursing Informatics in different work practise contexts for nurse practitioners.   The TIGER10however integrates these aspects defining nursing informatics as: "the integration of nursing science, computer and information science, and cognitive science to manage communication and expand the data, information, knowledge, and wisdom of nursing practice" [10]. Emerging technological innovations have resulted in the implementation of diverse ICT interventions in the management of patient information in nursing practise [4,2]. There is a need for nurses to be involved in the design, development and implementation of these novelties, for the creation of resilient relevant innovations. Nursing Informatics education empowers nurses to acquire the skill to "speak"(psychomotor skills) and comprehend (critically reflective cognitive action) a language (Informatics) that is foreign to nursing, yet essential for professional emancipation.

1.2   Nursing Work Practise

"Whether reviewing a patient's health history ,documenting an assessment, or researching evidence based guidelines for patient care, nurses are the consumers, purveyors and brokers of information" [9, 11, 12]. Emerging ICT Technology facilitates the management and interpretation of that information.   The problem is that nurses do not fully utilise ICT in their work practices [13, 14]. A possible reason for this could be that ICT is not sufficiently integrated in their work practices because nurses do not actively participate in the design and development of ICT solutions that could be useful to them. Informatics practitioners without hybrid skills in the health discipline, tend to impose systems that are not pertinent and sustainable in nursing practice [15]. It is therefore necessary to consider nurses also as co-designers of ICT solutions in addition to users of ICT solutions. The following roles for health informatics skills for nurses are suggested that nurses primarily in healthcare: use ICT; deploy ICT; and research ICT and/or develop ICT solutions [16].

1.3   Nursing Education

It appears as if the current nursing education and training courses in South Africa does not amply address the need to consider ICT solutions as part of healthcare service provision [17, 18, 19, 20, 21]. The first workshop conducted on Nursing Informatics Education needs in South Africa, was done during the period of recurriculating the Nursing and Midwifery macro curricula. Inclusion of Informatics courses to be implemented in 2016 by respective nursing education institutions is still at paucity and a holistic comprehension of role and inclusion of informatics in micro and meso curricula is required [18]. Likewise informatics courses and training may not sufficiently prepare developers to design and develop appropriate ICT solutions, systems and applications specifically for the healthcare domain [15, 18, 22]. In addition the context in which healthcare services are provided, influences the healthcare practices that will then require technology solutions to be aligned for the situated actions of healthcare professionals and workers for that context [23, 24]. The proposed nursing informatics education and training needs to be considered from both the nursing practise and health education view points, i.e. how should informatics be incorporated into health education and training and how should informatics education and training provide for nursing practices. These courses should also address the contextual aspects that influence healthcare service provision. The global courses and practices could serve as a starting point but cannot just be transferred to the African context [25].

2   Materials and Methods

The purpose of this paper is to describe the process followed to consider the inclusion of nursing informatics (NI) in the different education and training programmes in South Africa. NI is considered as the starting point rather than health informatics since there is currently not a clear idea about the extent of health informatics education in South Africa and there are many more stakeholders involved in healthcare services in general. Nursing informatics, although also having many stakeholders, has a single profession body in South Africa that governs the standard of nursing education and training [26]. The process described in this paper is a continuation of the health informatics fundamentals curriculum design process that was part of the Informatics Development in Health INDEHELA-ICI [27] capacity development project with participation by University of Eastern Finland, Eduardo Mondlane University, Mozambique, Obafemi, Awoluwo University, Nigeria and in South Africa the Cape Peninsula University of Technology and University of Western Cape.

2.1   Methodology

Two separate workshops were conducted within an interval of 6 months. Training providers were identified using a criteria of their expertise as determined in similar studies in the following areas : 1. Nursing ; 2. Nursing Education; 3. Health Policy [28,29,30], these were invited to two workshops 1.A two and a half day Nursing Informatics Education Needs Assessment workshop conducted in April 2014, and   2. A one day workshop on Educating the Educators conducted in November 2014. International academics from the INDEHELA network were invited to provide guidance for the process and to share their experiences with obtaining international accreditation for their health informatics programme. This helped to position the proposed courses in the global context with the consideration of the local context. Best practices and recommendations with the IMIA, Tiger group based on Staggers et al. [10, 31] for the South African context were shared and their definition of nursing informatics was used as a starting point.

   An inductive approach of collecting data was done using the following three methods: questionnaires, participatory co-design, and observations. The participants were observed during the workshop during the discussions and co-design sessions. Questionnaires were distributed to the participants, at the beginning and end of the workshop.

Nursing Informatics Education Needs Workshop.
The workshop was attended by twelve persons representing Nursing Educators from, three Universities in Western Cape; Various Nursing Trainers from the private sector and NGO's; the Department of Health; Nursing Councils; Instructional Design; and Information and Technology department. The aim of the workshop was to determine the needs for nursing informatics education in South Africa and to collaboratively design appropriate curricula for the different levels and offerings. The anticipated outcomes were to establish the: focus areas relevant to the Nursing Informatics needs in South Africa; relevant stakeholders and special interest groups; potential Nursing Informatics courses with relevant exit level outcomes; curriculum design plans for identified courses and the curriculum for the first course; potential content providers and delivery platform; and contact details of potential international partners. The participants were divided into three groups based on the three core target groups that were collaboratively identified at the beginning of the workshop each with a participant from the criteria determined. A Participatory co-design session was conducted to determine possible competency outcomes for each target group

Educate the Educators Workshop.
The workshop was attended by ten persons representing Nursing Educators from, various Nursing Training institutions from the private sector and NGO's; the Department of Health; and Information and Technology department of Cape Peninsula University of Technology. The aim of the workshop was to discuss the implications of health informatics in education specialties; evaluate the effectiveness of utilizing informatics in education setting in improving uptake of technology that improves access in

health; enable the integration of health informatics competencies for transformative education. The anticipated outcomes were to establish the determining the needs and opportunities for including NI courses in specialised nurse training courses.

The participants were divided into two groups based on their area of training each with a participant from the criteria determined, A Participatory co-design session was conducted to determine possible needs, and opportunities for NI in their curricula.

2.2   Materials

Selected Participatory Design Tools were employed, in order to facilitate the co-design sessions theses required the following materials and equipment as listed in Table 1.

Table 1. Tools and Materials used during PD session

Materials	Equipment
• Pen • Paper • Markers • Manila Cards • Sticky Notes • Colored Bond Sheets	• Camera

3   Results

3.1   Focus Areas Relevant to Nursing Informatics Needs

Participants identified the following Focus Areas, and provided steps needed to be followed in introducing NI Education.

Focus Areas	Steps to Introducing NI Education
• Need to advocate NI to relevant stakeholdersPaper • Continuous professional development (CPD) educationManila Cards • Standardised baseline records to convert to eRecords • Suitable learning platform • NI research • Formal NI curriculum for undergraduate, graduate and post graduate programmes	• NI capacity development by educating: the nursing and ICT educators; nursing and ICT students; practicing nurses and NI researchers • Identify suitable content providers and delivery and communication plat • Develop appropriate curriculum design plans • Establish a network of collaboration aligned around NI in Africa.

Table 2. Focus Areas and Steps to Introducing NI Education

3.2   Relevant Stakeholders and Special interest groups

An initial diagram of an overview of the Nursing Education structure was given for discussion to the participants [Figure 2]. A participatory design session was conducted to determine the direct and indirect stakeholders that can influence the implementation of Nursing Informatics Education within South Africa. The initial number of stakeholders was collapsed and a questionnaire given to the participants to rate using 0-5 scale rating questionnaire method, the level of power of influence, and level of benefit to be obtained in the introduction of NI in curricula. The results produced a listing of 26 stakeholders [Table 3]

Stakeholder Power of Influence	
Power Of Influence	
High	• International Collaborators • Media • External Organisations • Private Businesses • DPSA • Informatics Bodies and Associations	• Health Care Professionals • Community Advisory Board • Curricula Bodies • Health Education Support Entities • Health Education Institutes • Computer Professionals • Students • Future Employers • Health Facilities • Local Health Organisations • NRF • Patients • DHET • NDoH • Government (Local, Provisional, National) • HR/Finance
Low	• Consumer Bodies • Department of Public Works	• Citizen • Community • Admin Support
	Indirect	*Direct*
	Stakeholder Category	

Stakeholder Benefits Obtained	
Benefit Obtained	
High	• International Collaborators • Informatics Bodies and Associations • External Organisations • Private Businesses • Consumer Bodies	• Health Care Professionals • Community Advisory Board • Citizen • Health Education Support Entities • Health Education Institutes • Computer Professionals • Students • Future Employers • Health Facilities • Local Health Organisations • Community • Patients • NDoH • Government (Local, Provisional, National) • HR/Finance
Low	• DPSA • Media • Department of Public Works	• Curricula Bodies • DHET • NRF • Admin Support
	Indirect	*Direct*
	Stakeholder Category	

Table 3. Stakeholders Benefits and Power Of Influence

3.3   Potential Nursing Informatics courses

The following three levels were identified after the term nursing informatics was introduced: 1) undergraduate qualifications; 2) post graduate qualifications; and 3) continuous professional development (CPD) training for practicing nurses. A design of potential curricula competencies that can be introduced was done for all three programmes with the following outcomes

3.4   Curriculum design plans for identified courses

Table 4. Post Grad and Continuous Professional Development Recommendations

Post Grad Curriculum Design (10 credits Informatics Training in current curricula)	Continuous Professional Development Curriculum Design (10 Credit Course)

• Staggers' Level One Nurse Informatics Competencies(Pre-requisite) with a Pre-Course to be offered
• Level Two Competencies as follows
Computer Skills – Administration, Data Access, Monitoring, Quality Improvement,
Informatics Knowledge- Data, Impact, Privacy/ Security, Systems, Evaluation, Role.
	Target
	    Health Care Practitioners, Management
	Course 1- Basic Computer Literacy[4 credits]
	    Competency in
	        a. Word
	        b. Excel
	        c. PowerPoint
	        d. Emails
	        e. Internet
	        f. Information Literacy
	    Course 1 exemption will involve a pretest
	Course 2 – Specialized Health Systems Knowledge[6 credits]
	        a) Outcome : Manage and Influence specific Health Systems Applications to Specific Area of Expertise.
	        b) Provide Descriptions of Health Systems .
	        c) Apply General Systems to the Concept of Health Systems
	        d) Monitoring and Evaluation of Systems

Year	Working with Complex Data Sets		
1	Pretesting : Use of electronic devices and software to explore and communicate information Demonstrated the ability to use word-processing and multimedia software. Successfully navigate operating and filing systems	Explore different types of health care data sets applicable to nursing and midwifery Uses Sources of data that relate to practice and care	Enters, retrieves and accesses data used locally for patient care (e.g. uses HIS, CIS for plans of care, assessments, interventions, notes, discharge planning.) Uses database applications to enter and retrieve information Conducts online literature research
2	Use applications for structured Data Entry , interpretation and reflection	*	*
3 & 4	Year 3 & 4 dealt with across the two years	Advocate for the use of quality nursing data sets to improve nursing and midwifery data practice inclusive of data integrity	Use systematic review data for patient care enhancement

Table 5. Health Informatics: bachelor of nursing and midwifery (Three core competencies and broad outcomes over

Year	Patient Documentation		
1	Access and Retrieve Information	Appreciate the Use and Importance of Nursing Data for Improving Practice	Use a relevant application to document Patient Data
2	Use administrative applications to document and review relevant patient data	Critically analyze patient data	Use Information management Technology for patient education
3	Appreciate the realities of electronic communication and data management systems	Explore the ethical issues and solving of such around data utilization and management	*
4	Explore evidence based practice in terms of data use, management nationally and internationally	*	*

Table 6.

Year	Health Informatics Advocacy		
1	*	*	*
2	Explore Language and current conversations around Health Informatics	Create a conducive learning environment for teaching and learning Health Informatics	*
3 & 4	Launch a NI group project to develop and sensitize relevant communities of practice	Collaborate with stakeholders or peers for advocacy	Reflect on realities and issues on Health Informatics globally and nationally

Table 7.

3.5   Potential content providers and delivery platform

Infrastructural challenges were identified as a barrier to implementing NI in curricula. A suggestion from facilitators to utilise open source e-learning software available was considered, with Moodle and Blackboard, being the common platforms known. The application of an e-learning software creates a learning space for learners that promotes a mastery based learning, collaborative learning and provides a tool to enhance blended based learning.

3.6   Needs and Opportunities in Specialised Practises

Trauma/Paramedic Nursing.

During the co-design session the participants detailed the work practise of a Trauma/ Paramedic Nurse and the Informatics needs, opportunities and competencies needed by the nurse. Table 8 details the outcomes from the co-design session.

Table 8. Needs, Opportunities and Possible NI Competencies Required for a Trauma/Paramedic Nurse

Needs	Opportunities	Possible Competencies
• Technical Skills in device applications • Need to be competent in using application to assist in diagnosis and treatment • Information management • Infrastructure • Computer Monitoring and Evaluation tools • Networking • Communication Skills	• Simulation scenarios • Triage Device • Hands Free Devices • Vital Signs Monitors • Applicants (for ticking sheets) • Monitoring and Evaluation tools	• Basic Computer Skills Literacy • Entry and retrieval of data • Interpretation of data • Technical Skills • Informatics monitoring and evaluation skills

Midwifery Nursing.

The Midwifery participant group detailed out needs, challenges and competencies as shown in Table 9. In addition to this a possible micro curriculum that was drawn from Staggers competencies at four levels of practise level 1 and Level 2, for both Midwives and Informatics Students shown in Table 10 and Table 11.

Table 9. Needs, Opportunities and Possible NI Competencies Required for a Midwifery Nurse

Needs	Opportunities	Possible Competencies
• Co teaching in work place • Computer Literacy • Infrastructure • Learning Places • Human Resource Challenge	• Blogging Facilities • Counselling Facilities • Teaching Facilitation	• Basic Computer Knowledge • Basic Internet Competencies • Blogging Facilities • Counselling Facilities

Year 1	Year 2	Year 3	Year 4
• Basic Computer Literacy • Advanced Excel • Data Input • Analytics • Access of Online Information • Data Protection • Password correction • Levels of Access • Privacy application • Security	• Validation of Data • Data Accessing • Data Handling • Systems Maintenance and trouble shooting • Introduction to Databases	• Quality / Improvement of Data • Basic Research • Online databases • Advanced Databases • Project Management	• Budgeting • Forecasting • Staff Scheduling • Advanced Research • Report Creation • Project Management • Information Skills Training • Advocacy

Table 10. Micro level competencies outcomes for Midwifery Nursing , drawn from Staggers competencies at four
levels of practice for Nursing Informatics Nurse.

Table 11. Basic Nursing Competencies needed by Informatics Practitioners working in Midwifery (Depth of Content
to be determined)

**Informatics
Practitioners**

- Observations
- Basic Care
- Ethos at entry level
- Practice at entry
  level
- Community Nursing
- Sociology
- Midwifery

3.7 Attitude, Needs, Challenges

A further analysis of the instruments showed that there was a positive attitude towards the implementation
of NI education and training courses. Feedback from the questionnaire indicated the following needs and
challenges Table 12:

Needs	Challenges
- A broadband is needed for the Introduction to the concept of NI - need for meaningful integration of NI into the Nursing Sciences programmes - standardisation of the programmes will be necessary across institutions - knowledge skills are lacking - acceptance and integration of NI need to be considered on a national level	- limited infrastructural and capacity resources - Policy - technological interventions infrastructural - data privacy and security

Table 12. Broadband Needs and Challenges to NI Education Introduction

3.8 Positive and Negative Feed Back

The following positive remarks were made about the workshop:

- A general sense of a positive attitude towards Nursing Informatics was present in the workshop
  evidenced with the change in curricula at Macro level. Only one negative comment was present
  requiring bigger premises for facilitation:
- Participants were however eager to implement a Continuous Professional Development program, and
  to attend the Fundamentals course.

4 Discussion

The need to introduce NI in nursing education and training was established although the participants felt
that the concept of NI is not well understood and therefore there is a need for advocacy. NI should be
included in all levels of NI education and training and that this should be done on a national level. The
current competencies and materials are a good starting point but there is a need to consider the contextual
aspects as well. The experiences of the international facilitators were very useful and the process should
provide for more consultation with international partners. The Participatory involvement of both nurses
and IT representation was viewed as beneficial as the participants felt that the other viewpoints resulted in

more clarity, bringing all expertise to the discussion. It is not clear who the driver should be for the process and although there is a commitment to continue with the process, it is not clear how this could be done in practice. The current South African education system with courses offered by domain specific departments and faculties makes it difficult to position multi-disciplinary courses such as NI. There was also a strong need to consider NI research at the same time as a mechanism to build NI capacity.

The purpose of this paper was to describe the process to introduce NI in South African education and training programmes and to share the results of the first workshop. It is clear that NI needs to be included in the different education and training programmes on the different levels and as much as the international programmes are valuable resources, it may be valuable to learn more about implementing NI in the African context. The different African initiatives in Africa may need to be aligned also so as to capitalise on local resources.

5   Conclusion

Identifying the stakeholders who need to be involved in the process of designing nursing informatics courses is important to ensure buy-in. This needs to be done before continuing with the process. It is also important to align any courses to both the international accredited ones as well as to initiatives from other African courses. The local context needs to be considered for relevant content and for realistic technology solutions. It is important to develop capacity for educators who can teach these courses, any plan should include a component on educating the educator.

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The architecture landscape of electronic health information systems in South Africa

Boniface Kabaso[a,*], Gillian Khan [a], David Makola[a]

[a] Cape Peninsula University of Technology , Cape Town South Africa

Background and Purpose: The South Africa National Department of Health NDoH approved the National Health Normative Standards Framework (HNSF) for Interoperability in eHealth in April 2014. According to the announcement, NDoH stated that up to date eHealth investments have not created the desired 'network effect' because of lack of interoperability between heterogeneous IT systems. As a solution, the interoperability framework has been developed to be used to achieve the desired network effect.

The framework prescribes the requirements for the use and exchange of digital data to support healthcare in order to optimise healthcare delivery, research and education

A recent study conducted by the National Health Normative Standards Framework for Interoperability in eHealth (HNSF) found that there are 42 systems currently in use across the country that record transactions specifically in support of patient administration and care.

According to the findings, only 12 systems are based on interoperability standards. With the approval of the interoperability framework, the challenge now is bring the other 30 systems in line with the standards.

Methods: Architectural analysis of the 42 systems to identify the architecture styles used

Results: The key contribution of this paper is a highlight of the architectural gaps faced by systems that do not comply and a proposal of an accelerated paths to compliance with the approved standards.

Conclusions: This paper is a study of the architecture of both the systems that meet the approved standards and those that do not.

Keywords: Architectures Interoperability EHealth

*Corresponding author address: Cape Peninsula University of Technology, Zonnebloem, 8000, Cape Town, South Africa, Tel:+(27)-(021) (460 3713), E-mail: kabasob@cput.ac.za

Implementing data warehouse solutions in the health sector: lessons from the Kenya HMIS project

Mwenda Gitonga[1], Ali Karisa[1], Brian Wakhutu[1], Mysha Sissine[2], Joshua Oiro[1], Donna Medeiros[2], Bobby Jefferson[2]

[1] Futures Group Morningside Office Park, Ngong Road, Nairobi, Kenya
[2] Futures Group, One Thomas Circle, Washington, DC 20005 USA

Background and Purpose: Futures Group through a CDC co-operative agreement has been working with the Kenya Ministry of Health (MoH) to develop a patient-level data warehouse and business intelligence (BI) solutions to ensure that electronic patient care data is used in real-time decision making.

Methods: While the Kenya MoH has been investing in information communication technology (ICT) implementations to improve service delivery, a number of these implementations are silos leading to multiple un-integrated systems. This has consequently deprived policy makers and the general public of a rich and centralized repository of data for country level business intelligence, analytics and reporting capabilities. To address this challenge, the Kenya MoH and Futures Group have started development of a HIV centric data mart to further understanding of the requirements, design, implementation and data security needs of developing a National Level Data Warehouse and BI solution.

Results: The computerization of patient medical records together with the goodwill of stakeholders in the Kenya MoH has made it possible to consolidate patient data for decision making in a centralized data repository. There continues to be a need for rigorous processes to be undertaken in development of data governance policies around patient data security and administration

Conclusions: In order to develop a meaningful and sustainable data warehouse, the Kenya HMIS project aims at increasing technical capacity within the ministry through workshops and other stakeholder engagement forums. A culture of data demand and information use is also being cultivated at health facilities with an aim of not only developing analytics capacity at the health facility but also improve on the quality of data generated by these facilities.

A mobile platform to facilitate counselling as well as health information and education dissemination to people in resource-restricted communities

de la Harpe, R., Kabaso, B., Debrah, R.D.

Cape Peninsula University of Technology, Cape Town, South Africa

Abstract. In resource-restricted contexts access to relevant health information, education and counselling is limited and often these people are isolated from assistance that could benefit them. In addition to the shortage of healthcare resources in these contexts, people are often also not aware of what is possible through the use of technology. On the other hand technology solutions in developed contexts are not appropriate for developing contexts. The bulk of health information and education is still in the global space with people having the information and digital literacy skills to search and utilise health information and education to manage their own health and wellbeing. However, most of the health information and education dissemination and transfer in resource restricted contexts still happen during meetings and courses and not where and when needed. There are also many diseases and conditions associated with poverty that have a stigma attached to it that make open discussions and information seeking problematic. People therefore do not seek help because they are afraid that their problem will become known. The specific area that the use of this platform considers is that people must be able to anonymously seek for assistance, information and education that are presented in a manner that is understandable to them when and where needed.

Today the emphasis of healthcare services is also on health promotion and disease prevention rather than only on treating diseases. It is also much wider than focusing only on diseases to also extend to the wellbeing of individuals. The role of intermediaries is becoming more important in resource-restricted contexts to reach people who may not have sufficient health, information and digital literacy to access relevant sources. Health promoters, registered nurses, lay counsellors and care givers are essential people to extend healthcare services to the point of care, often to communities isolated from healthcare services. These intermediaries also need to be empowered with access to information and education relevant to them during their health service practices. For example, caregivers being confronted with a situation unknown to them that requires assistance from a coordinator and healthcare professional at another location.

This demonstration illustrates how a mobile platform can be used in the African context to increase access to relevant health information, education and assistance.

The demonstration of the mobile platform will have three components:

— Demonstrating how the platform can be used for health promotion and education as well as disease prevention
— A life demonstration of MobieG as an advisory and counselling chat platform that has already assisted more than 55 000 young people with advice on issues such as teenage pregnancy, rape, STD, suicide, etc. The people use an anonymous chat facility to interact with advisors, counsellors, legal experts and healthcare professionals. This facility is available on feature phones, smart phones and web sites. Many of the persons assisted are from African countries
— Visual information and education to reach people with a lower literacy level.

The use of standardized tools for monitoring of a Laboratory Information System in Ghana

Bernard Nkrumah[1*], Philip Boakye[2], Anthony Ofosu[3], Sidney Akuro[2], Samuel Duh[2], Ava Onalaja[4], Patrick Njukeng[2], Reshma Kakkar[5], Amitabh Adhikari[6], Celia Woodfill[1]

[1]Centers for Disease Control and Prevention, Ghana.
[2]Global Health Systems Solutions, Accra, Ghana.
[3.] Ghana Health Service
[4]Association of Public Health Laboratories
[5]The St. John Group, Atlanta, USA
[6]Centers for Disease Control and Prevention, Atlanta, USA

Background and Purpose: Basic Laboratory Information System (BLIS), an open source laboratory information system (LIS) has been successfully implemented in twelve public sector laboratories in Ghana to improve data quality, timeliness, and increase laboratory efficiency. Monitoring systems supporting clinical and public health programs can identify new challenges and validate improvements. Standardized tools were developed to monitor BLIS implementation in Ghana

Methods: The BLIS implementation team developed a) a pre-implementation survey to capture existing systems and processes, b) a post implementation survey with comparable parameters conducted 6 months after BLIS implementation, and c) weekly reports to monitor quality indicators.

Results: The pre- and post-implementation surveys showed time required to log in patient/specimen data, and enter results decreased by 72% and 78% respectively. Time to search results and generate monthly reports declined by 96% and 98% respectively. Volume of patient demographics captured daily increased by 29%. Error rate when using BLIS dropped by 82%. The volume of patients whose data were captured in BLIS showed a 7.1% increase and a 7.25% increase in the quantity of specimens with data entered into BLIS. Staffs ability to use BLIS increased with the ability to edit patient's record increasing by 34%.

Conclusions: These tools demonstrated the utility of continuous monitoring of the LIS as implementers stayed informed about improvements and used indicators with declining results for further investigations. These data provided information on BLIS quality indicators and use by laboratory staff, identified implementation gaps, corroborated strategic decisions on implementation improvement and compared performance of BLIS and paper-based systems in parallel use

Keywords: Quality LIS Monitoring Standardized Implementation Laboratory

Statement on conflicts of interest.
  There are no conflicts of interest

*Corresponding author address: Centers for Disease Control and Prevention, U.S. Embassy, No. 24 Fourth Circular Road, Cantonment, Accra, Ghana, Tel: +233-(54) (4336985),E-mail: vyu4@cdc.gov

Principes architecturaux pour le développement d'une architecture entreprise e-santé pour la RDC

Amisi Fataki Clément [a*], Shamashanga Pierrot[b], Karara Gustave[c], Verbeke Frank [c]

[a] Université de Kinshasa – UNIKIN, Kinshasa, DR Congo
[b] CEMUBAC, Kinshasa, DR Congo
[c] Vrije Universiteit Brussel - VUB, Brussels, Belgium

Contexte et objectif: Plusieurs principes ont été nécessaires afin de mettre en place une architecture entreprise e-santé pour la RDC. Dans cette étude nous avons présenté les différents principes qui ont été utilisés pour élaborer le PNDIS sur base de la méthodologie TOGAF. Finalement, certains principes ont été retenus par rapport aux contextes de la RDC

Méthodes: le Plan National de Développement de l'Informatique de la Santé (PNDIS) a été élaboré sur base des principes suivant la méthode TOGAF. L'étude montre la liste de principes potentiels avec évaluation de chaque principe par rapport au contexte de la RDC, argumentation et sélection des principes

Résultats: L'étude montre que les besoins de développer certains principes au contexte de la RDC dès le départ est nécessaire pour l'architecture entreprise e-santé. A partir de la méthode TOGAF nous avons eu développé ces principes sur le plan architectures métier, applicative, des données et technologiques.

Conclusion Dans le cadre de cette étude, les principes de la méthodologie TOGAF nous ont permis de définir les nouveaux principes architecturaux propres au contexte de la RDC.

Abstract (English)

Context and objectives : Several principles were necessary to implement an enterprise e-health architecture for DRC. In this study we presented the various principles that were used to develop the PNDIS based on the TOGAF methodology. Finally, some principles are applied to the contexts of the DRC

Methods : The National Plan for the Development of Health Informatics (PNDIS) was developed based on the principles following the TOGAF method. The study shows the list of potential evaluation principles with each principle to the context of the DRC, and argument selection principles

Results :The study shows that the need to develop some principles to the context of the DRC from the start is necessary for e-health enterprise architecture. From the TOGAF method we had developed these principles to the architecture profession map, application, data and technology.

Conclusion : Conclusion In this study, the principles of the TOGAF methodology allowed us to define new architectural principles specific to the context of the DRC.

Keywords: Méthode, Principe, Architecture, e-santé, Entreprise, République Démocratique du Congo

1   Introduction

Dans le cadre de la mise en œuvre du Plan National de Développement Sanitaire 2010-2015 (PNDS), le Ministère de la Santé Publique de la RDC a décidé d'élaborer un plan directeur visant le renforcement du système national d'information sanitaire. Cette initiative trouve son origine dans la définition des résultats du deuxième axe du PNDS qui stipule que "l'information sanitaire est disponible pour la prise de décisions à tous les niveaux et le renforcement du leadership du MSP sur l'ensemble du secteur". Ce résultat devrait être réalisé à travers 5 programmes d'appui [5]:

— Le renforcement du système d'information;
— L'amélioration de la qualité de l'information;
— L'amélioration de l'utilisation de l'information ;
— Le renforcement de la communication ;
— La réforme du système national d'information sanitaire

Quelques 'importants problèmes liés à la gestion de l'information sanitaire sont constatés aujourd'hui:

— De multiples initiatives qui ont été programmées ou sont en cours d'implémentation dans le cadre des programmes d'appui au système d'informations, sont principalement pilotées et/ou gérées par des bailleurs et témoignent trop souvent d'un manque de coordination et d'interfaçage inter-projet
— L'appropriation par le MSP des projets NTIC dans le domaine de la santé reste trop faible. Cela est à l'origine d'un manque de pérennité des projets, qui ont tendance à disparaître avec les bailleurs qui les avaient initiés
— Les missions, objectifs et normes au sein du MSP par rapport aux NTIC ne sont pas clairement définis. Par conséquent, on constate un trop faible leadership dans ce domaine au niveau du MSP. Aussi, le cadre organique actuellement mis en place, ne semble pas adapté aux défis d'un système de santé moderne qui ne sait plus se passer de l'informatique.

Pour remédier à ces problèmes, un plan directeur pour la mise en œuvre de la vision NTIC formulée dans le PNDS, s'impose [5,2].Dans un monde de plus en plus dématérialisé, poussé par les avancées technologiques, les investissements économiques et les évolutions socioculturelles, il semble évident que le secteur de la santé devra inévitablement intégrer les NTIC dans ses activités. Ce constat s'applique, qu'il s'agisse de proposer à tous les citoyens des soins de grande qualité, équitables et sûrs, ou de remplir les obligations en matière de recherche, de rapports et d'action humanitaire dans le domaine de la santé publique[9].

Pour la mise en œuvre de la vision NTIC dans le secteur de la santé en RDC, la future architecture entreprise e-santé doit respecter certains principes. Les principes d'architecture apportent une aide précieuse dans cette vision stratégique de l'architecture. Ils établissent un ensemble de règles et de recommandations, qui favorisent l'harmonisation des choix et des pratiques [3].

Dans notre étude nous proposons les principes métiers, applicatifs, des données et technologiques à mettre en place dans le cadre du développement d'une architecture entreprise e-santé basée sur la méthodologie TOGAF en RDC

2   Matériels et méthodes

Pour assurer son leadership dans les investissements NTIC de son domaine, le Ministère de la Santé Publique (MSP) de la RDC a lancé une étude sur l'élaboration d'un Plan National de Développement de l'Informatique de la Santé (PNDIS). L'objectif était d'établir une architecture entreprise e-Santé. TOGAF définit les composantes architecturales de l'entreprise en tenant compte d'un nombre de principes. Des principes sont des règles et directives générales et stables qui sont rarement amendées et qui fournissent à l'entreprise les règles de conduite pour la réalisation de ses missions.

Les principes peuvent se présenter sous forme de valeurs, actions ou même résultats. En fonction des besoins, des principes peuvent être définis à trois niveaux différents [2,3]:

— Les principes d'entreprise forment une base pour les processus de prise de décisions et sont particulièrement importants pour la gouvernance de l'architecture
— Les principes technologiques d'informations guident l'usage et le déploiement des ressources informatiques à travers l'entreprise. Souvent ils sont mis en place avec un souci d'optimaliser le rapport coût-efficacité des investissements informatiques.
— Les principes d'architectures sont plutôt liés au travail architectural et reflètent la façon depenser au sein de l'entreprise. Ils peuvent se manifester comme des principes de procédures liés à la création et la maintenance de l'architecture, ou des principes d'implémentation qui guident les premières phases de mise en place de solutions informatiques.

Un principe est composé de 4 éléments [3]:

─ Dénomination du principe
─ Explication (descriptif du principe)
─ Idée fondamentale du principe
─ Implications métiers et techniques

3   Résultats

TOGAF préconise l'établissement des principes d'architecture au plus tôt, comme élément fédérateur des chantiers à venir [3]. Après analyse approfondie de la future architecture e-entreprise au contexte de la RDC, une suite des principes architecturaux ont été développés dans le cadre du Plan National de Développement de l'Informatique de la Santé.

3.1   Principes métiers

a. Les processus métiers doivent se conformer aux lois pertinentes de la RDC, les
b. politiques, les règles et règlements. Le Ministère de la Santé Publique doit se conformer à toutes les lois, les politiques, les règles et règlements de la RDC.
c. La gestion de l'information sanitaire doit s'appliquer aux secteurs de la santé dans son entièreté. Le respect de ce principe fournira une mesure plus fiable et quantifiable du niveau de la qualité et de l'information dans le secteur de la santé.
d. Les processus doivent être partagés entre le ministère et les autres organisations de la santé. Pour atteindre les objectifs ou les buts attendus du MSP, des changements dans la planification et la gestion de l'information organisationnelle seront nécessaires. Les différents services doivent abandonner les préférences individuelles pour le bénéfice de l'ensemble du Ministère de la Santé Publique. Les services de soins, les fonctions ou les processus doivent être continus afin de servir l'ensemble des citoyens, indépendamment des événements internes ou externes et doivent avoir des options ou des mécanismes de substitution. Rien ne doit entraver ou perturber les activités du MSP, c'est à dire les catastrophes naturelles, défaillances matérielles ou d'Internet, et d'autres. Les fonctions de gestion doivent se poursuivre éventuellement par l'utilisation de méthodes alternatives. Des applications courantes doivent être utilisées et améliorées pour éliminer les chevauchements et d'optimiser l'utilisation de ressources. Les processus doivent être optimalisés pour pouvoir être gérés par des applications courantes.
e. Les structures du MSP développent et mettent en œuvre des solutions technologiques ou des processus pour améliorer ou soutenir leurs fonctions. Des processus efficients et efficaces peuvent être pris en charge par les solutions d'information et de technologies de communication.
f. Les structures du MSP doivent se donner la main pour travailler ensemble pour atteindre des objectifs communs. La gestion de l'information doit être l'affaire de tous et chacun devra s'engager à mettre en œuvre ce principe.

3.2   Principes applicatifs

a. Les applications sont indépendantes de la technologie. Ce principe permettra aux applications d'être développées, mises à jour, et exploitées de la manière la plus opportune et rentable.
b. Les applications doivent être conçues pour être faciles à utiliser. Facilité d'utilisation peut être réalisé en ayant des normes d'interface communes pour faire fonctionner le système. Des connaissances et compétences semblables doivent suffire pour l'exploitation de plusieurs systèmes qui sont essentiellement similaires entre eux.

3.3   Principes de données

a. Les données sont une ressource précieuse pour toute organisation. Des données précises et promptes sont essentielles pour la prise de décisions précises et adéquates. Les données sont le fondement de la prise de décision et doivent être gérées avec soin.
b. Les données doivent être partagées entre les processus métiers ou les fonctions. Des données de qualité dans une application qui peuvent être partagées permettront d'éliminer les doubles emplois et d'améliorer le processus de décision.
c. Les données doivent être accessibles aux utilisateurs pour effectuer leurs fonctions. L'accès aux données aide à améliorer l'efficience et l'efficacité dans la prise de décisions et pour la fourniture de services de soins de santé.
d. Une instance doit être responsable pour la qualité des données. Cette instance est chargée de veiller à l'exactitude et l'actualité des données.
e. Il doit y avoir des normes pour les données communes. Données qui seront utilisées dans le développement de systèmes d'application doivent se conformer à une nomenclature nationale pour la santé gérée par le MSP.
f. Les données doivent être sécurisées. Les données doivent être protégées contre toute utilisation ou divulgation non autorisée.

3.4   Principes techniques

a. Un changement technique est fondé sur les besoins de l'entreprise et doit être rendu conforme. Les changements doivent répondre aux exigences de l'entreprise et ne pas changer l'entreprise en réponse aux changements de l'information et de la communication.
b.   Les logiciels et le matériel doivent être interopérables pour les données, les applications et la technologie. Des normes techniques devront promouvoir la cohérence et améliorer la gestion des systèmes, des ressources et des investissements.
c.   Des normes techniques conduisent à des économies d'échelle. La diversité technologique peut être limitée pour minimiser les coûts de maintenance et de support technique et pour améliorer la gestion.
d. Les technologies choisies doivent être répandues, robustes et accessibles. Les technologies à sources libres seront préférées.

4   Discussion

Dans cette étude nous avons développé les différents principes à respecter pour mettre en place une architecture entreprise e-santé comme le stipule la Méthode TOGAF. Sur base des analyses nous avons énuméré certains principes nécessaires considérés comme préalables sur le plan architectures métier, applicative, des données et technologiques. La méthode TOGAF ne donne pas de principes génériques mais elle veut que certains principes soit définit dès le départ. Une série des principes architecturaux ont été retenus par rapport au contexte de la RDC. Chacun de ces principes a été justifiés sur le plan architecture métier, applicatifs, de données et techniques [3,9].
    Les principes métiers exigent que :

— les processus métiers se conforment aux lois pertinentes du pays,
— la gestion de l'information sanitaire puisse s'appliquer aux secteurs de la santé dans globalité,
— les processus doivent être partagés entre le MSP et les autres organisations.
— Les services de soins et les processus doivent être continus à fin de servir les citoyens,
— les applications courantes doivent être utilisées et améliorées,
— les structures du MSP doivent s'approprier les solutions NTIC de même elles doivent travailler dans l'unité afin d'atteindre les objectif [3].

L'analyse des principes de la méthode TOGAF a permis de dégager les principes architecturaux pour le développement d'une architecture entreprise e-santé pour la RDC.

Remerciements

Nos vifs remerciements au Ministère de Santé Publique de la République Démocratique du Congo qui a rendu possible cette étude, en particulier le Secrétariat Général et la Direction de l'Etude et de la Planification. Nous remercions toutes les personnes qui ont participé à la réussite de cette étude en particulier les équipes cadres des programmes de santé, des DPS et des Bureaux centraux des ZS.

Conflits d'intérêt

Aucun

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Information communication and community development: the case of Grabouw, Cape Town, South Africa

Ralitsa D. Debrah [a]*, Sophie V. Bhebe [a], Retha de la Harpe [a]

[a] Cape Peninsula University of Technology, Cape Town, South Africa

Information and Communication Technologies (ICTs) are fast growing in Africa, Asia, Latin America and many other parts of the world. In South Africa these rapidly growing technologies are being used to facilitate access to healthcare. This has made considerable impact in some rural communities in the country. However, in this paper, researchers explore the use of ICTs for community development in 'the Grabouw area. The purpose was to find out *"what ICT solutions can be suggested that could facilitate access to health information in the Grabouw community*. The authors present their experiences, lessons learnt, procedures and outcomes of the research in this article.

The area for this research was in the Western Cape in the Grabouw community. Members of this community are predominantly farmers. However, this research was conducted as part of the association between Cape Peninsula University of Technology (CPUT) and Elgin Learning Foundation (ELF), an NGO based in the Grabouw municipality. This NGO supports the training and development of indigenes in the area with a core focus on training home-based healthcare workers. Through these services, caregivers are able to reach patients in remote areas in the township. ELF encourages community participation by usually encouraging *"bottom-approaches"* meaning involving end-users in the beginning of the design process to find solutions. This way, personalised ICT enabled solutions can meet complex and emerging problems in healthcare services provided in the community.

Further, in order to explore possible ICT solutions for community empowerment, service design methods were used to identify sustainable and innovative ICT solutions that could facilitate access to health information. Following earlier studies conducted in the community, with a purpose of understanding the context of the Grabouw case study, a three day workshop was organised using participatory and co-design approaches. It was "dubbed INDEHELA access intensive course". Participants were mainly grouped into interdisciplinary teams of five. Each team had about four to five members with a tutor assigned, guiding them through the process. The participants were mainly from disciplines such as Information Technology, Health and Design. The first day was characterised by interactive sessions where participants engaged with tutors. They were mainly briefed on how to explore ICT solutions to facilitate access to healthcare. On the second day, participants journeyed and interacted with caregivers in the Grabouw community to identify their needs to determine ICT interventions. The next day, participants shared information obtained and possible ICT solutions proposed with teachers and other participants present on the closing day.

Interesting results were obtained from these design engagements with the community. Team members proposed possible innovative ICT solutions that could facilitate access to healthcare in the community. The study revealed that caregivers and some community members have access to smart phones, television and radio. Therefore it was important at this point to consider ICT solutions using fewer resources to achieve more. Thus, frugal innovation concepts were factored into the proposed solutions. Some of these ideas included multimedia messaging platforms, healthcare applications and community radio station that could facilitate access to health information.

Considering ICTs to facilitate access to health information is potentially a viable medium of communication in the Grabouw community. These solutions should make meaning, be culturally acceptable and personalised towards the needs of end-users to facilitate easy interaction with proposed ICT solutions. However, it must be re-echoed that outcomes documented in this paper, were proposed within a short timeframe. Nevertheless, it is suggested that further research should be conducted exploring service design methods, as discussed in this article, towards creating innovative and sustainable ICT solutions for community development and empowerment.

Key words: ICT, healthcare-design, South Africa

*Corresponding author address: CPUT, 80 Roeland Street, 8000, Cape Town, South Africa, Email:ralibebe@gmail.com
Tel: +27 (0) 7249062149/ +233 (0) 244 485572

Informatics for Universal Health Coverage in Africa: From Point of Care Systems to National Strategies