

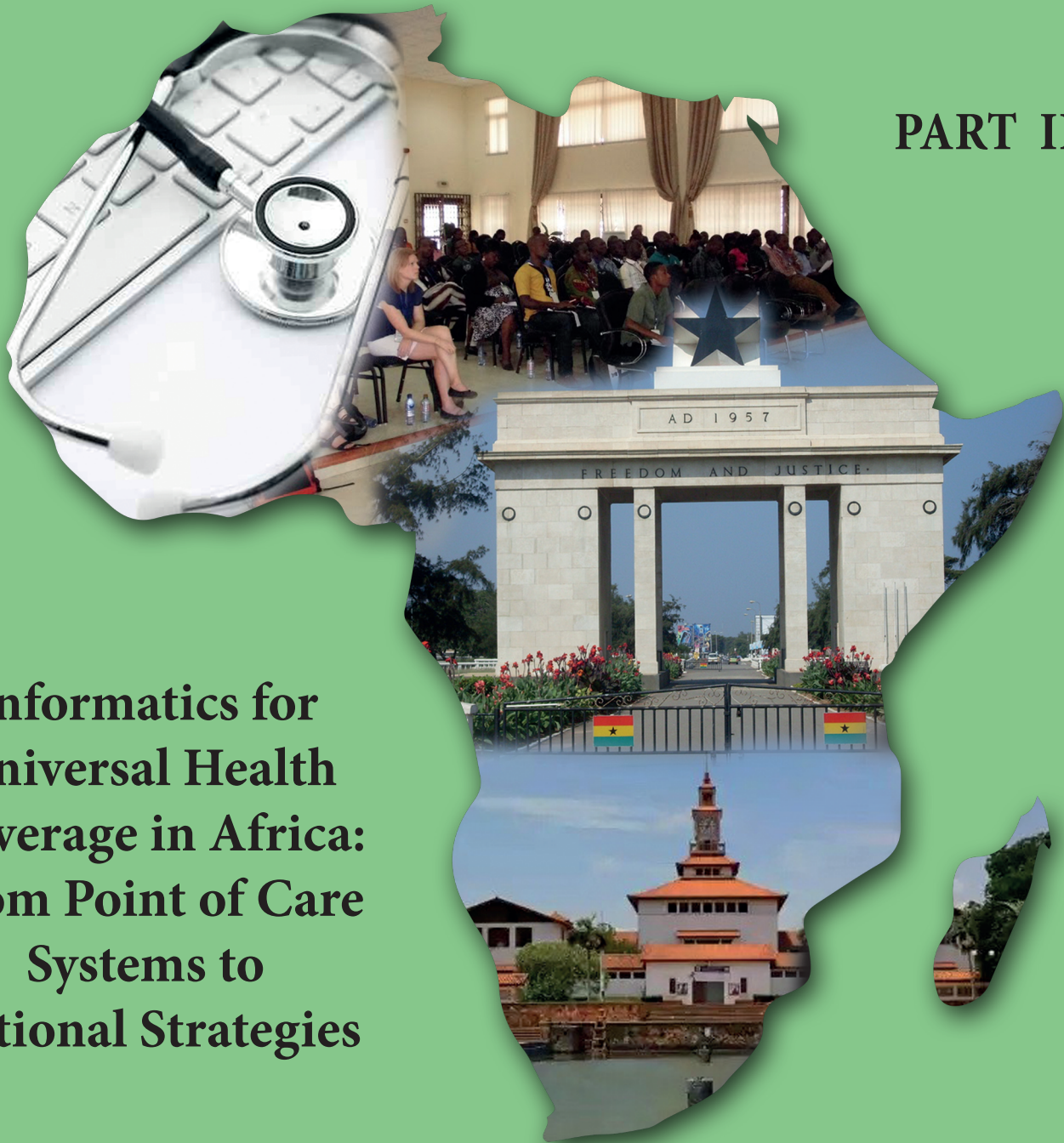
Proceedings of the 9th Health Informatics in Africa Conference

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PART II

**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

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The HELINA 2014 conference

The 9th HELINA (HEaLth INformatics in Africa) 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 were 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

9th Health Informatics in Africa Conference (HELINA 2014)
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The Ethiopian national eHealth strategy and its alignment with the health informatics curriculum

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Background: Many countries have developed eHealth strategies based on the WHO and ITU eHealth strategy toolkit. However, the success of the strategy, which appears to influence the diffusion of eHealth systems, is mainly dependent on the availability of skilled health informaticians at all levels. The purpose of this paper is therefore to review the Ethiopian eHealth strategy draft with respect to expertise requirements and to compare it with the graduate profile of the only bachelor in health informatics program in Ethiopia.

Methods: A comparative analysis of the eHealth strategy with the curriculum of the bachelor in health informatics program was done. In the analysis, we identify the main focus areas of the eHealth strategy and compare its coverage in the academic and practical competency areas of the curriculum.

Results: The eHealth strategy identifies five main areas of priorities for health information system implementations. They are: Health information systems, Telemedicine, mHealth, eLearning (for health workforce training) and community information systems. The curriculum contains 62 ECTS courses directly related to those areas. Additionally, the curriculum contains 89 ECTS for strategic and communication level skills, 108 ECTS for technical level skills, and 50 ECTS for monitoring and evaluation level skills.

Conclusions: The eHealth strategy expertise and the curriculum are well aligned, especially regarding the technical level skills. The department and the ministry must work together so that the students get practical experiences of all the courses during their study.

Keywords: eHealth, Ethiopia, Developing country, Health informatics education, Success

1 Introduction

The use of information and communication technology (ICT) to support healthcare services is rapidly increasing. Public healthcare organizations, in most developing countries, are becoming increasingly reliant upon ICT to support healthcare services by improving the ability to collect, manage, analyze and report information in all areas of healthcare [1].

eHealth generally is defined as the use of ICT for health and in a broader sense the World Health Organization (WHO) defines eHealth as “a method concerned with improving the flow of information, through electronic means, to support the delivery of health services and the management of health systems” [2]. For national healthcare systems it is used to improve the timeliness and accuracy of public health data reporting and to facilitate disease monitoring and surveillance activities as well as supporting sector-wide planning by improving the ability to plan, budget and deliver services.

Ethiopia is at a pivotal moment in its efforts to improve the health status of its people and address health inequities. As the country has made progress in reaching the health-related Millennium Development Goals, the government realizes that these advances need to be accelerated if targets in the areas of maternal and child mortality and infectious diseases are to be achieved [3]. eHealth is one

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potential avenue to keep this progress. The Ministry of Health (MOH) of Ethiopia has developed and tried various national eHealth applications that include: Electronic Medical Record –(EMR) system, mHealth, Telemedicine, eLearning and other initiatives [3]. Even though most eHealth projects are at different stages, separated initiatives and experiments have created enough interest that health decision makers are beginning to explore how eHealth could be integrated into health systems more comprehensively [4] but according to the ministries report, the lack of well trained, workforce is hindering its progress.

Training knowledgeable, motivated and capable healthcare information technology (HIT) staff is essential for overcoming the barriers to effectively implement eHealth systems. With this firm interest and ambitious plan, it is evident that the country needs health informatics professionals who are aware of the complex health care processes and who can manage, plan, develop and provide expert consultations to the health care sector. To fill this gap, the University of Gondar - one of the oldest research, teaching and community service oriented higher education institutions in Ethiopia - designed a health informatics bachelor's degree program.

The aim of the bachelors' program is to train students who can model, develop and implement different health information system applications as well as evaluate and monitor impacts of such applications within the healthcare organizations. This program is the only bachelor's level health informatics program that bridges the diploma and master training programs in the country. The success of the country's eHealth strategy implementation is highly dependent on those graduates. Therefore it is necessary to ensure that what the students are studying in the university is in line with the eHealth strategy needs. Hence, the purpose of this paper is to review the eHealth strategy of Ethiopia and compare it with the University of Gondar's bachelor program graduate profile.

2 Materials and methods

For this study we performed a comparative document analysis. We reviewed the draft eHealth strategy of Ethiopia [5] and the bachelors health informatics curriculum of the University of Gondar [6]. With the eHealth strategy review, we identified the priority focus areas of the strategy and the type of skills and expertise each of the implementation targets need. After identifying those priority areas, we reviewed the course content of the curriculum and compared it with the main expertise needs of the eHealth strategy.

3 Results

In our review of the draft eHealth strategy, we found out that it is a result-oriented document containing a clear vision of eHealth in the health system of the country. The document contains main rationales, reviews of current infrastructures, human resources, and main components, areas of intervention, financing as well as monitoring and evaluation plans.

The main objective of the strategy is “to create standardized, integrated and harmonized e-health systems to enhance health service delivery” [5]. Moreover, the document identifies specific targets of eHealth in the country in the area of health system enhancement in terms of access, quality and efficiency; expanding evidence based planning and decision making at all levels of the healthcare and standardization of electronic communication and data exchange in the country. Furthermore, the document describes five priority areas in health information systems implementations. They are: Health information systems, Telemedicine, Mhealth, eLearning (for health workforce training) and Community information systems. The strategy document also discusses five strategic areas of interventions for eHealth: 1) adapt e-health standards, 2) implement the national ICT infrastructure 3) establish governance and leadership, 4) educational promotion to all stakeholders on eHealth and 5) support human resource development and capacity building for eHealth (HIT, informatics).

In our review of the curriculum we found out that it is a multi-disciplinary curriculum with a total of 249 ECTS. It comprises of different courses in health, ICT and general knowledge courses. The 1st and the 2nd year of the study have a focus on health courses to provide students with a solid understanding of healthcare. The 3rd and 4th year of the study focus on advanced level informatics course. The last year is dedicated to an internship within a real healthcare setting to get to know different implemented eHealth systems. The details of the curriculum courses and its development approach are discussed in a separate publication [6]. During the comparative analysis of the eHealth strategy needs with the bachelor's

curriculum, we found out that most of the skill needs of the strategy are covered by course level competencies in the curriculum as discussed below.

3.1 Courses for main priority domain areas

The eHealth strategy identified health information system, telemedicine, and mHealth, e-Learning and community information system as the main priority system applications to be implemented in the country. To respond to those competencies needs the curriculum has 11 main courses with a total credit of 62 ECTS.

Table 1. Lists of main courses in the curriculum for the competency of priority health information system domains in the eHealth strategy of Ethiopia.

Strategic and communication level courses	Credits (ECTS)
Health management information system	6
Medical knowledge based systems	6
Health information system practical attachment	6
Telemedicine	5
Mobile health information system	5
Outpatient and inpatient information systems	5
Health information project management	4
Health record system	6
Teaching skill for health informatics	4
Health informatics project I&II	16
Total	63

3.2 Strategic and communication level skills

Soft skills are becoming important for health informaticians given the complexity of healthcare eHealth implementations [2]. This competency is covered in 17 courses with a total of 89 ECTS.

Table 2. List of main courses in the curriculum for the competency of strategic and communication level skills in the eHealth strategy of Ethiopia.

Strategic and communication level courses	Credits (ECTS)
Communicative English	5
Civics and ethical education	5
Health service management	5
Health economics	3
General psychology	4
Introduction to sociology	4
Health information project management	4
Basic writing skills	5
Pharmacology	3
Health management information systems	6
Hospital operation systems	3
Team training program	8
Teaching skills for health informatics	4
Entrepreneurship	4
Practical attachment I	8
Team training program	8
Practical attachment II	8
Total	87

3.3 Technical level skills

Courses that are intended primarily to educate the technical competencies of graduates are listed in the following table 3. We found a total of 19 courses with 108 ECTS in programming, infrastructure implementation, advanced level data handling and specific eHealth application courses in the curriculum. The eHealth strategy clearly outlines that health informaticians who are going to work in the health sector (from primary care centers to MOH offices) need to have multidisciplinary technical skills.

From the technical point of view, the curriculum covers every dimension of technical courses including programming, networking, computer maintenance, hospital device maintenance, server installation and management and others. This is in line with the current needs of the health sector. Due to budget constraints and the size of small health centers and clinics, it is difficult to employ health informaticians for all aspects of the hospital. In order to address all the difficulties those professionals need to have multidisciplinary skills to ensure the first site assistance for all technological matters.

Table 3. List of main courses in the curriculum for technical level competencies in the eHealth strategy of Ethiopia.

Strategic and communication level courses	Credits (ECTS)
Fundamentals of ICT to health informatics	5
Fundamentals of health informatics	5
Biostatistics for health informatics	5
GIS & disease mapping	5
Object oriented system analysis & design	7
Discrete mathematics	5
Fundamentals of programming (C++)	5
Data structures and algorithms	5
Internet programming	7
Fundamentals of database systems	5
Information storage and retrieval	5
Medical knowledge based systems	6
Biomedical instruments	5
Computer maintenance & troubleshooting	6
Computer networking and security	6
Telemedicine	5
Mobile health information systems	5
Health informatics project I	8
Health informatics project II	8
Total	108

3.4 Monitoring and evaluation skills

For the competency of monitoring and evaluation, there are a total of 50 ECTS courses, including a dedicated monitoring and evaluation course.

Table 4. List of main courses in the curriculum for the competency of monitoring and evaluation in the eHealth strategy of Ethiopia.

Strategic and communication level courses	Credits (ECTS)
Epidemiology for health informatics	5
Biostatistics for health informatics	5
Health service management	5
Monitoring and evaluation	5
Health management information systems	6
Health information project management	4
Health informatics project I	8
Team training program	8
Health informatics project II	8
Total	54

4 Discussion and future perspective

Establishing a national eHealth strategy has become a significant milestone in national health system development plans. Having a concrete national plan and a clear vision allow for resources to be appropriately distributed and used. Ultimately, the development of a national strategy is a starting point for the long journey of the vision [7].

We assigned each course to the competency area we believe it primarily affects, based on the objective and content of the course. Generally every course has a direct or indirect influence to all competency areas. This categorization helps us to have a clear understanding of each area and to analyze the requirements with the curriculum content. In the analysis we found out that most of the credit points were part of the technical level skills (108 ECTS), which is in line with the eHealth strategies requirements that explicitly outline the need of more technical professionals in its implementation plan.

Even though, the course content and distribution of credit points to each of the competency areas have addressed most of the eHealth strategy document requirements, we believe that those classroom based lecture and academic level practicum courses are not enough to build the competencies. The MOH, Regional Health Bureau (RHB) and the Gondar university health informatics department need to collaborate closely so that students can participate and get familiarized in the development, implementation and evaluation of different eHealth projects during their study.

The availability of the “Health informatics project I & II” course with a total of 16 credit hours, “team training program” with a total of 8 credit hours and “practical attachment to a healthcare organization” with a total of 8 credit hours are ample opportunities to build this skill. If the students get the opportunity to participate in different eHealth projects during those courses, we believe that will give them the technical, strategic and monitoring and evaluation level skills. For that, the collaboration of the department with MOH and other non-governmental organizations who are involved in eHealth implementation is necessary.

We recommend a further detailed and more comprehensive pedagogical study on how best each competency can be achieved in the curriculum. Additionally, a similar analysis is needed on identifying where the diploma and the master level graduates fit into the eHealth strategy requirements.

5 Conclusion

The eHealth strategy of Ethiopia and the bachelor health informatics curriculum at the University of Gondar are 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 MOH need to work together so that the students get practical experiences of all the courses during their study period.

Acknowledgements

We would like to acknowledge all the people involved in the development of the Ethiopian national eHealth strategy document and the Health informatics curriculum of University of Gondar.

Statement on conflicts of interest

There is no conflict of interest.

6 References

- [1] Vital wave consulting, “Health Information Systems in Developing Countries,” Vital wave Consult. no. May, p. 69, 2009.
- [2] WHO and ITU, “National eHealth Strategy Toolkit,” WHO Libr. Cat. data, vol. W26, no. 5, 2012.
- [3] N. ELIAS, “Special bulletin,” MOH Spec. Bull., vol. 15th Annual, no. 15, pp. 43–46, 2013.
- [4] N. Framework, “mHealth in Ethiopia Strategies for a New Framework,” MOH Publ., vol. 6, no. 1, 2011.
- [5] M. Engida and M. Kifle, “eHealth Strategy 2013-2015,” 15th Annual. Rev. Meet. Spec. Bull., vol. 6, pp. 43–47, 2013.

- [6] B. Tilahun, A. Zeleke, F. Fritz, and D. Zegeye, "New bachelors degree program in health informatics in Ethiopia: curriculum content and development approaches." *Stud. Heal. Technol.* pp. 798–802, 2013.
- [7] C. Hamilton, "The WHO-ITU national eHealth strategy toolkit as an effective approach to national strategy development and implementation." *Stud. Health Technol. Inform.*, vol. 192, pp. 913–6, Jan. 2013.

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The European initiative EHR4CR – Lessons learned for EHR implementations in Africa

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Nowadays, more and more clinical data are documented in electronic health records and are thus available in digital form. With the aim of re-using these data for clinical research, a European consortium consisting of 35 partners from academia, clinics, pharmaceutical companies and subcontractors initiated the project "Electronic Health Records for Clinical Research" (EHR4CR). Three different services are envisaged to be supported for the design and implementation of clinical trials using a single platform: Clinical protocol feasibility, Patient identification and recruitment, Clinical trial execution and Serious adverse event reporting. Four different working groups focus on the following areas: Specifications and Business Model development, Technology Platform and Tools including semantic interoperability and data protection/security, Pilot Activities and Reference Site coordination as well as communication, dissemination and project management. It became apparent that one critical issue to reuse clinical data is the availability of structured, standardized data elements at the hospital sites.

African countries that are currently implementing or planning to implement EHRs are strongly advised to make use of medical terminologies and data dictionaries when designing their systems. Medical documentation should be as structured as possible and interfaces be made available in order to reuse clinical data for reporting or research purposes. A common data inventory for medical documentation and health management reporting could be a starting point.

Keywords: Electronic health records, hospital information system, clinical trials, Single source, Secondary Use

1 Introduction

Electronic health records (EHR) are more and more implemented in hospitals and a lot of clinical data are being collected in digital form. It has many advantages to have patient data available in an electronic, structured format: Data are available at the right time to the right people and can be used for treatment planning and follow-up. Furthermore, once collected data can be reused for secondary purposes like quality management reports for the hospital or clinical research [1]. Clinical studies rely on good data and oftentimes these data are collected redundantly during patient visits. This double documentation can be avoided if the EHR systems are prepared to collect data in a structured and reusable form and offer tools to export this data for secondary purposes [2].

The EHR4CR project (<http://www.ehr4cr.eu/>) was initiated in 2011 to explore the possibilities of reusing data from EHRs for clinical trials and to design a technical platform together with a respective business model [3]. This public-private partnership was enabled by the Innovative Medicine Initiative (IMI) and is funded jointly by the European Union and the European Federation of Pharmaceutical Industries and Associations (EFPIA). It runs for 4 years with a total budget of 16 million Euro and consists of 35 partners (pharmaceutical companies, research institutes, university hospitals, small enterprises). The project objectives are to support the main phases during a clinical trial by (re)using EHR

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data. The first is ‘clinical protocol feasibility’ in which the trial is being planned by estimating potential study patients and designing the study protocol. The second is ‘patient identification and recruitment’ in which the study patients are recruited at the different participating sites. The third is ‘clinical trial execution’ and ‘serious adverse event reporting’ in which patient data during the trial is being documented.

The objective of this paper is to present the EHR4CR project and relevant lessons learned. The experiences can be used while designing and implementing EHR systems in African countries or for future similar projects on the African continent.

2 Materials and methods

To achieve the objectives, the project was divided into four thematic groups and a total of eight work packages as depicted in figure 1. It was planned to develop a common EHR4CR platform to connect different, decentralized data provider sites and make their anonymised EHR data available for clinical research.

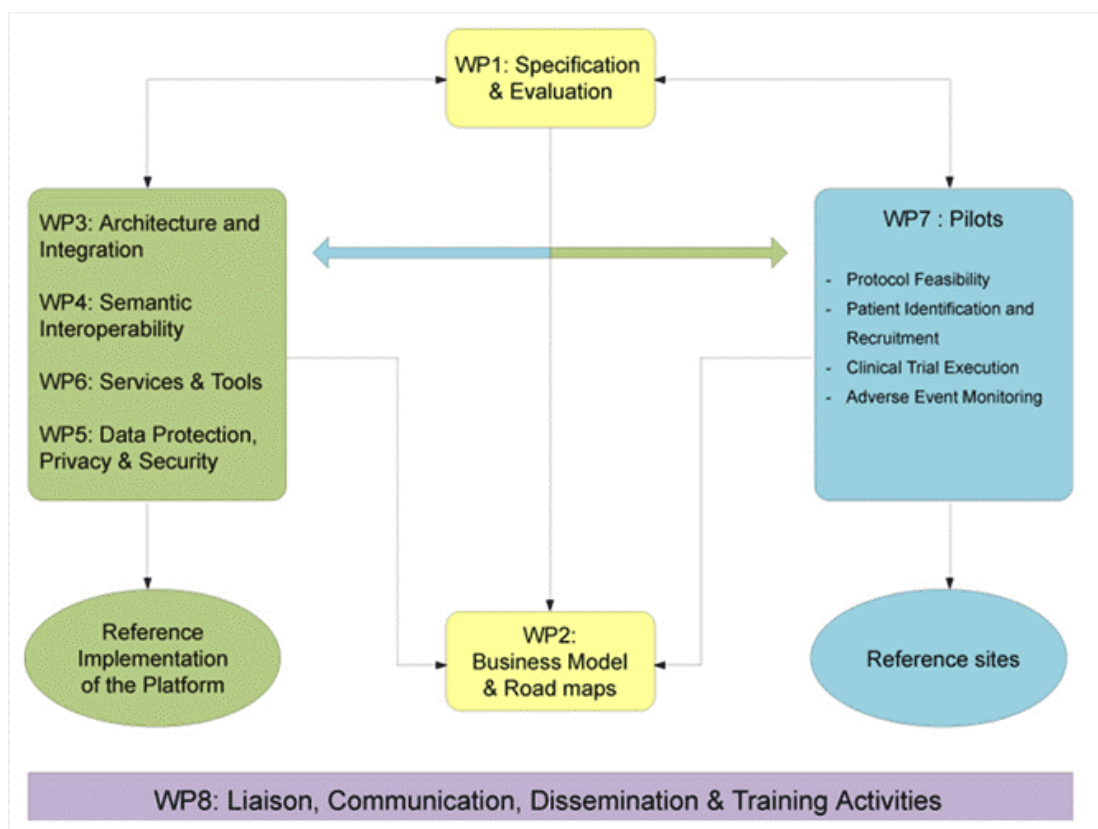


Figure 1. EHR4CR project organization with eight work packages (WP). Work package groups (WPG) consist of one or more WPs and are marked with the same color (e.g. WPG1 with WP1 and WP2).

The first two work packages (WP1 and WP2) focus on collecting requirements and developing the business model. Work packages 3-6 are the core of the project because through them all tools and services of the EHR4CR platform are developed and methods for data privacy across national legislations are established. Work package 7 coordinates the implementation of the different components at the eleven participating data provider sites across five countries and evaluates the piloting of the platform. Finally work package 8 manages the overall project and coordinates dissemination activities.

3 Results

During the last three years the EHR4CR platform was developed and installed at different European hospitals to query EHR data for research purposes. For the first scenario of protocol feasibility it was demonstrated that data across different EHRs in Europe can be used to obtain numbers about potential study patients faster than on the usual way of sending feasibility questionnaire to potential sites. Through the EHR4CR platform a study feasibility query is distributed to all selected and participating data provider sites. In the local data warehouses the queries are executed and resulting numbers are sent back to the central platform to display aggregated results. Figure 2 and 3 show a sample query and the aggregated results in the central component of the platform.

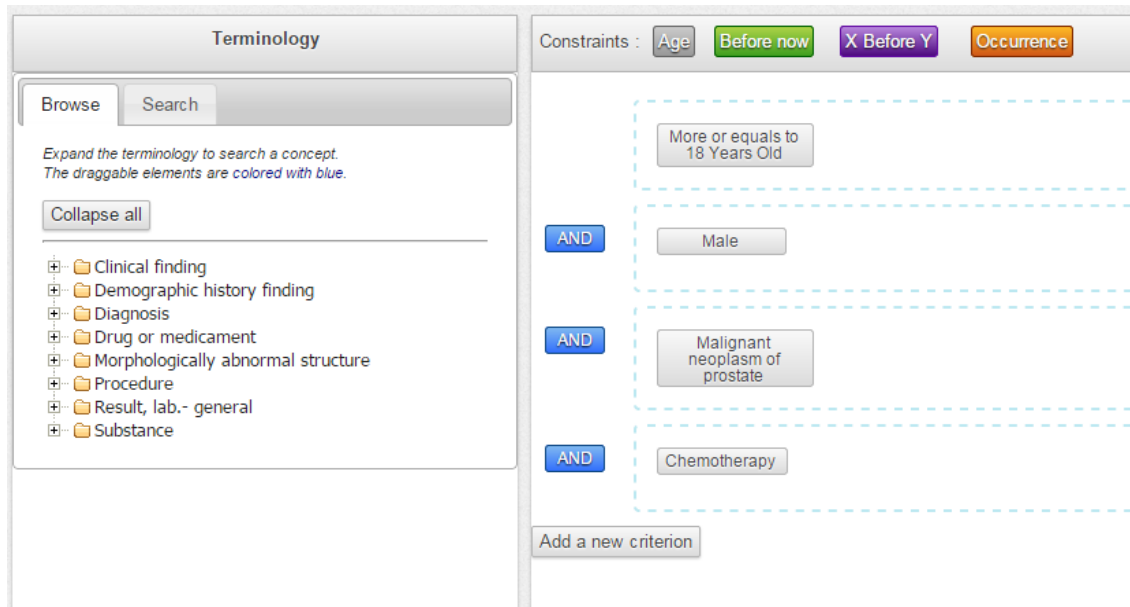


Figure 2. This shows the drag & drop query builder with the available terminology to choose from on the right side; in the example we searched for male patients older than 18 years with prostate cancer who had a chemotherapy.

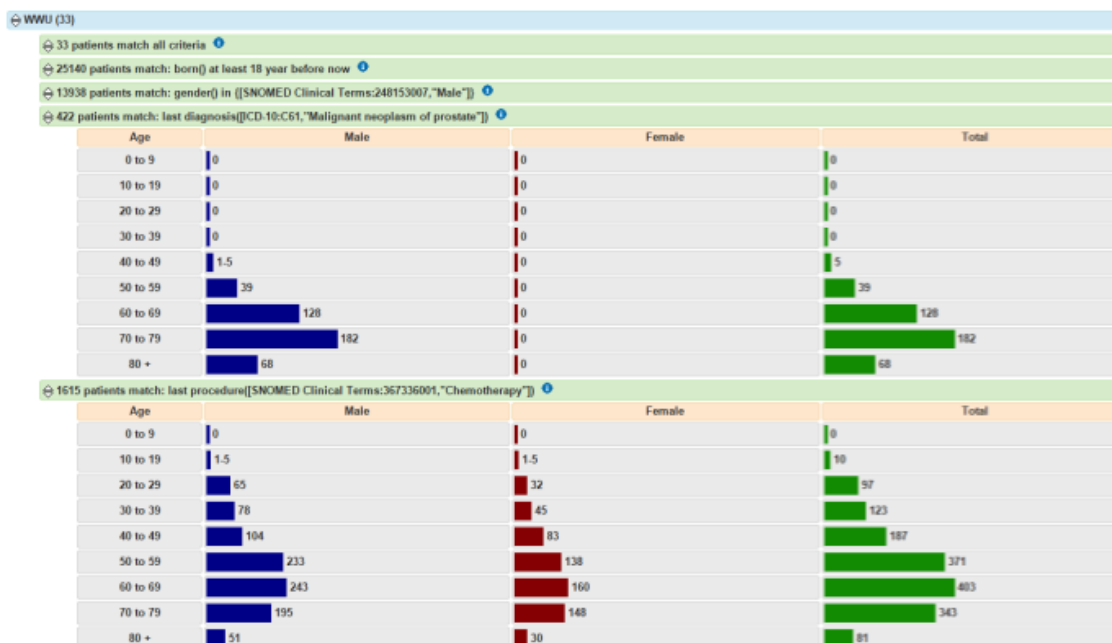


Figure 3. The results show aggregated numbers of all queried data provider sites which can also be displayed in a detailed view showing the resulting numbers for each single criterion (as seen here for site “WWU”).

The second scenario for patient identification and recruitment is based on the same principle. Queries with the inclusion and exclusion criteria of the study protocol are distributed to the participating hospital sites. Query execution is done locally in specific data warehouses and results are only available for the local principal investigator so that he/she can decide to get in contact with the patient for recruitment. Only aggregated numbers of the finally recruited patients per site are sent back to the central platform to the respective EFPIA company.

Extensive work has been done to make EHR data available at the sites. A prerequisite was the development of methods to adhere to the different legislations regarding data privacy. Furthermore we analysed EHR data and data elements typically needed in clinical trials and created a data inventory of the most commonly needed elements [4]. Those data elements became part of the EHR4CR core terminology to which all sites mapped their EHR data in the specific data warehouses. Through this common terminology (based on standard medical terminologies wherever possible) we were able to formulate one query and execute it at eleven different sites with different data being available in different languages. This decentralized approach proved to be feasible.

3.1 Main lesson learned

During the analysis of data elements being available in the EHRs of the different sites it became apparent that a key issue was format and quality of the data. Not all data elements were available in the EHRs and of the available ones only some have been documented in a structured format, mainly diagnosis codes and demographic data. The bigger part of clinical data from the medical history was often only available in free text. In addition, very few data were tagged with common medical terminologies like SNOMED codes. The data quality was very diverse across the different sites.

Furthermore a common data exchange language had to be created to transfer data to the platform. Extensive mapping work had to be done during ETL (extract, transform, load) processes to make the data elements queryable using the common EHR4CR vocabulary.

However, it has been possible to reuse commonly available, structured EHR data across different sites using a single platform for the purpose of clinical research.

4 Discussion

To answer the question which of these experiences can be used while designing and implementing EHR systems in African countries we would like to focus on the above described issue of data quality and interoperability. Based on the experiences from the EHR4CR project our strongest recommendation is to ensure structured medical documentation based on standard medical terminologies when EHR systems are designed or implemented. Oftentimes EHR systems have grown over many years with no or little thought on data structures and dictionaries or their data collection is based on different objectives and thus results in very diverse data quality [5]. Results of the previously mentioned review by Häyrynen et al. on EHRs can be confirmed [1]. However, we can see that it is possible to reuse EHR data.

In a setting like in most African countries where EHRs are currently on the upsurge [6] we would like to encourage all healthcare providers and policy makers to take the chance and implement systems through which structured documentation and easy data exports are possible. Even further, trial management functionalities and supporting modules for all of the above mentioned scenarios should be included to facilitate clinical research in an efficient way for African countries. As a bonus, well-structured systems might also encourage health professionals who are not familiar in using electronic systems for their documentation. Knowledge about clinical terminologies and standards like SNOMED and HL7 or self-defined data dictionaries needs to be acquired and used for any system that is being installed. Metadata should be standardized to ensure integration on regional/national levels or as seen in the EHR4CR project even between countries. An inventory of data elements commonly used for medical documentation and reporting issues, as just presented for clinical trials, could be a starting point to harmonize data collection.

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Statement on conflicts of interest

There is no conflict of interest.

References

- [1] Häyrynen K, Saranto K, Nykänen P. Definition, structure, content, use and impacts of electronic health records: a review of the research literature. *Int J Med Inform.* 2008 May;77(5):291-304.
- [2] Prokosch HU, Ganslandt T. Perspectives for Medical Informatics - Reusing the Electronic Medical Record for Clinical Research. *Methods Inf Med* 2009; 48: 38–44
- [3] Coorevits P1, Sundgren M, Klein GO, Bahr A, Claerhout B, Daniel C, Dugas M, Dupont D, Schmidt A, Singleton P, De Moor G, Kalra D. Electronic health records: new opportunities for clinical research. *J Intern Med.* 2013 Dec;274(6):547-60.
- [4] Doods J, Botteri F, Dugas M, Fritz F, EHR4CR WP7. A European inventory of common electronic health record data elements for clinical trial feasibility. *Trials.* 2014 Jan 10;15:18.
- [5] Aiga H, Kuroiwa C, Takizawa I, Yamagata R. The reality of health information systems: Challenges for standardization. *Biosci Trends.* 2008;2:5–9.
- [6] Akanbi MO, Ocheke AN, Agaba PA, Daniyam CA, Agaba EI, Okeke EN, Ukoli CO. Use of Electronic Health Records in sub-Saharan Africa: Progress and challenges. *J Med Trop.* 2012;14(1):1-6.

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Developing a national e-health strategy for DR Congo: a preliminary analysis of business needs, existing information systems and solutions

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Background and purpose: In order to reclaim its leadership and to better align existing and future ICT implementations in the health domain with the strategic options defined by the National Plan for Health Development, the Ministry of Health (MoH) of the DRC initiated early 2014 the development of a national e-health enterprise architecture. During the preliminary phase of the architecture development cycle, an initial analysis of human resources, business processes, hardware, software, communication and networking infrastructure related to health information management, had to be established.

Methods: A first part of the study consisted of a detailed analysis of regulatory documents and strategic plans related to the Congolese health system and health informatics development. In a second part, field visits and semi-structured interviews were organized with a representative sample of relevant health structures throughout the country

Results: The study demonstrates the large number of business needs that must be addressed by e-health initiatives. It also documents the donor driven unequal distribution of hardware equipment over health administration components and health facilities. Internet connectivity remains problematic and few health oriented business applications found their way to the Congolese health system. Paper based instruments remain predominant in DRC's health administration. The study also identified a series of problems introduced by the uncoordinated development of health ICT in DRC such as the lack of standardization, data security risks, poor data quality, inadequate ICT infrastructures, an unregulated e-health sector and insufficient human capacity.

Conclusions: The results confirm the precarious situation of the Congolese health information system but they also expose a number of bright spots that provide hope for the future: a political will to reclaim MoH leadership in the health information management domain, the readiness to develop e-health education and training programs and the opportunity to capitalize the experiences from early successes with DHIS2 and a number of hospital information management systems.

Keywords: eHealth enterprise architecture, TOGAF, Health information systems, Democratic Republic of the Congo

1 Introduction

The Ministry of Health of the Democratic Republic of the Congo (MoH) has developed in 2006 a Health System Strengthening Strategy [2], which was reviewed in 2010. This strategic plan was further translated by the MoH and its technical and financial partners into a series of objectives and results in the National Plan for Health Development 2011-2015 [1]. Amongst the objectives were the reinforcement of the National Health Information System and the restoration of the MoH leadership in the field of health information management. Therefore, a number of interventions have been put in place:

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- A Program for Reinforcement of the National Health Information System, focusing on regulation, coordination between national and provincial levels and development of better solutions for structured health information gathering.
- A Program for Health Information Quality Improvement, including human resource capacity building, production of improved health information collection tools, private sector integration and development of data collection procedure reengineering.
- A Program for Improved Health Information Utilization, targeting the implementation of central and provincial health data warehouses with practical information dashboards and the promotion of research based on routinely collected health data.
- A Program for the Strengthening of MoH Communication, covering health information dissemination, the development of a website for the MoH and the implementation of a national electronic communication network for the health sector.
- A Program for the Health Information System Reform, aiming at the progressive replacement of the actual indicator oriented data collection mechanisms with solutions based on secondary use of data from patient-centric registration systems (electronic health record, billing systems, vertical health programs...)

In spite of the efforts put in the implementation of these programs, many issues remain today which prevent an efficient and effective health information management at the MoH:

- The MoH still has no leadership in the health information management domain giving way to a disorderly implementation of many donor-led ICT solutions that don't effectively address other than the donor's objectives.
- Software solutions often remain limited to basic office applications and few departments have implemented appropriate business solutions addressing their functional needs.
- The lack of means for electronic communication compromises the transmission of data from peripheral health structures to national data warehouses
- There is almost no harmonization of solutions between directorates and national, provincial and district levels of the MoH, hindering data merging and centralization.

In order to reclaim its leadership and to better align existing and future ICT implementations in the health domain with the strategic options defined by the National Plan for Health Development in DRC [1], the MoH initiated early 2014, with financial backup of the Belgian Technical Cooperation, the development of a national e-health enterprise architecture. The Open Group Architecture Framework (TOGAF) [11] was chosen as the reference methodology for developing this architecture. During the preliminary phase of the architecture development cycle, an initial analysis of human resources, business processes, hardware, software, communication and networking infrastructure related to health information management, had to be established. This study describes the objectives, methods and findings of this preliminary analysis.

2 Materials and methods

The main objective of the preliminary analysis was to provide a reliable estimation of the existing human and material resources and issues related to health information management in RDC. This study was part of the preliminary phase of a complete e-health enterprise architecture development cycle according to the TOGAF methodology, and therefore its output had to address a number of expectations defined by TOGAF. Summarized, the analysis focused on providing answers to the following questions:

- What are the MoH business needs in terms of health information management?
- Which health information management applications have already been implemented in the field and to what extent do they address specific business needs?
- What data is being collected today by the MoH and what is the quality of it?
- Which technologies (software, hardware, and networking) are being used today in the health domain in DRC?
- What are the important health information management problems today in DRC?

A first part of the study consisted of a detailed analysis of a number of regulatory documents [9, 10] and strategic plans related to the Congolese health system implementation [1, 2, 3, 4, 5] and health informatics development [6, 7, 8].

In a second part, field visits and semi-structured interviews were organized with a representative sample of relevant structures of the MoH throughout the country. For the sake of completeness and standardization, a study-specific interview guide [12] has been developed and was systematically used by the interviewers.

A study of regulatory documents and strategic plans took place in May and June 2014. After that, a first series of field visits and interviews have been organized with 39 relevant MoH and -related structures in the Kinshasa region:

- The secretariat-general and all 13 MoH directorates
- Major health programs (hiv/aids, tuberculosis, mental health, universal health coverage, vaccinations, national health accounts)
- Donor agencies and technical partners (Belgian Technical Cooperation, European Union, World Health Organization)
- Health facilities (University Teaching Hospital of Kinshasa, Ngaliema Reference Hospital, Reference hospitals of Kisantu and Monkole)
- Educational institutions (University of Kinshasa, School of Public Health, ISTM Kinshasa, ISIPA Kinshasa, CEDESURK)
- Telecom operators and ISPs (Airtel, Orange Telecom, Vodacom)
- Other organizations (National Center for Pharmacovigilance, MoH IT-professionals council, Prime Minister's Office)

In the period from July-September 2014, the e-health architecture development staff also visited 5 other provinces. In total a sample of 5 provincial health offices (45%), 55 health zone administrations (11%) and 69 hospitals (13%) have been analyzed by the study, representing an overall coverage of more than 10% of the MoH structures.

Province	Provincial health office	Health district administrations	Health zone administrations	Hospitals	Educational institutions	Research organizations
Bas Congo	1		5	6		
Katanga	1	4	12	14	2	
Northern Kivu	1		10	13		1
West Kasai	1		18	20	2	
Oriental Province	1		10	12	2	

Table 1. Field visits organized in 5 provinces outside Kinshasa

After an introduction on the purpose of the interview, representatives of each structure have first been questioned about the mission, the mandate and the vision of their organization, the objectives, the functions and the roles fulfilled and the way the work is organized. After that, a detailed analysis was made of health information management related human resources, ICT solutions and non-ICT (paper based) instruments at their disposal and existing procedures for exchanging health information with other (MoH or non-MoH) organizations. Finally, an analysis was performed of health information management problems, expected benefits, potential threats and the perceived importance of health ICT for each component of the organization.

3 Results

3.1 Business needs

The most important business needs that were identified in our study have been brought together in a list of 10 business chapters:

- Human resource management constitutes a major challenge for RDC's health sector. Unique health worker identification will be a first mandatory step towards developing individual work contract

management (covering public servants as well as locally contracted workers), salary and payment management, career management, qualifications and competence management, leave management and disciplinary record management.

- Operational management of material resources is a second chapter that must be developed; it not only covers a physical inventory of the health system's assets, but also the careful planning of maintenance and quality control and inspection operations.
- Financial resources are poorly managed in today's public health system in RDC. There is a lack of normalized accounting plans, nomenclatures for provided health services, and coding systems for donors, gifts, loans etc. No information system for budget planning has been put in place. Follow-up of public tenders is a predominantly manual procedure as well as the management of tender guarantees and insurances. Finally, there is a huge need for implementing a solution for standardized general and analytic accounting at all levels of RDC's public health system.
- Regulation and normalization are essential tasks of the many directorates at the central level of RDC's Ministry of Public Health. Unfortunately, newly created normative documents do often not fully take into account existing legislation due to a lack of legislative consolidation. The creation of a consolidated health legislation (*Code de la Santé*) using appropriate ICT tools has been identified as a priority for the MoH.
- Paper based health information management in RDC's public health facilities is outdated and hardly functional. The introduction of integrated health facility information systems covering hospitals, health centers and community health workers is a must. Such systems must include modules for individual electronic medical record management, financial transactions management, pharmacy, lab and medical imaging management, paper based health record filing, preventive medicine and statistical reporting. Integration of basic solutions for tele-consultation and tele-expertise must help to cope with the chronic lack of clinical expertise in rural RDC.
- The lack of health-ICT qualifications with RDC's healthcare workforce will require the development of large scale health informatics training programs at academic (post-graduate and undergraduate), non-academic higher education and community levels.
- The use of ICT-tools for health-related research must be stimulated and developed. Existing research initiatives must be inventoried as well as published papers and work in progress.
- National aggregate health data collection and production of health indicators suffers from poor quality source data due to the massive use of redundant paper based data collection instruments, which are not integrated with care-oriented data registration procedures. Data collection for national reporting is therefore perceived by many users as pure administrative overhead. Public health data collection development should therefore focus on integration with existing business processes of care oriented data registration (e.g. secondary use of individual health record data extracted from EMR systems).
- Planning of public health sector activities and spending is poorly organized. Few well-functioning experimental solutions exist at the central level of the MoH, but their content is poorly disseminated to the lower levels of the health system. The use of ICT-solutions for health system planning should focus on execution and monitoring of activities identified in the National Plan for Health Development (PNDS), human resource planning, material resource management, financial resource planning, harmonization of donor and NGO interventions and inter-sector or inter-ministry coordination.
- A last business chapter identified the important need for electronic communication solutions in RDC's health sector. The daily transfer of all kinds of business data between the more than 120.000 public health workers constitutes a huge challenge for a country that suffers from unreliable power- and network infrastructures. Still, the need for solutions that enable the production of letters and structured office documents, the rapid exchange of information between health workers and third parties, the archiving of huge amounts of information, the publication of information of public interest and the implementation of workflow logic, must be properly addressed.

3.2 Hardware

The study showed that computer hardware has most often been supplied to the MoH within the scope of donor-driven intervention programs. There is no organization-wide management of computer equipment and therefore distribution of hardware over the different MoH directorates, provincial or zone administrations and hospitals is very heterogeneous: some structures which are supported by several donors are very well equipped, others remain without any computer hardware at all.

Generally speaking, hardware specifications are quite standard: desktop PCs with Windows XP and Windows 7 operating systems, of which a large number have limited functionality due to computer virus infections (there is no budget available for keeping antivirus software databases up to date and most of the PCs have no access to internet for performing updates anyway). PCs are almost systematically accompanied by an uninterruptible power supply (UPS), but due to the lack of battery maintenance, the protection offered by these UPSs is minimal.

Most of the executive staff make use of laptop computers which in about half of the cases are their personal privately owned equipment.

Many of the MoH structures own one or more printers. Most of them are individual printers that are not being shared in a network. Toner and ink cartridge supply is very problematic due to unavailability of toner cartridges on the Congolese market or absence of a budget for that kind of operational costs.

Files and documents are commonly transferred from one computer to another using USB memory sticks, which constitute an infamous source of virus infections.

3.3 Networks

At the central level (Kinshasa region), most of the MoH structures have a local network (wired or Wi-Fi) at their disposal. Sometimes, these networks are connected to the internet thanks to donor funding, which unfortunately is always limited in time (and sometimes also in data volume). Internet bandwidth offered by local ISPs in Kinshasa is poor and unstable. Although optical fiber connectivity has recently become available in Kinshasa and Lubumbashi, excessive government taxation has prevented the expected price drops or improved availability of high-bandwidth internet in Kinshasa.

Installation of internet connections is uncoordinated, resulting in some structures accumulating several (poorly performing) parallel connections on the same site: 7 different wired internet connections have been identified at the site of the secretariat-general, without taking into account the dozens of individual 3G-USB modems offered by some donor programs. Remarkably, in spite of the generally unreliable internet connectivity, most MoH structures at the central level state that an internet connection has become indispensable for their activities.

Outside the capital and larger cities such as Lubumbashi, Mbuji-Mayi, Kananga, Goma or Kisangani, the situation is completely different. Wired internet connections are almost systematically unavailable and performance of 2G and 3G wireless data networks is extremely poor. Donor agencies (such as DFID, EU or Global Fund) are increasingly equipping MoH structures with VSAT connections, which have the advantage of providing stable and reliable bandwidth. Unfortunately, they come with high operational costs, causing the internet connection being unavailable part of the time due to inappropriate use (downloading of movies or audio) which can consume all of the monthly foreseen VSAT credit in only a few days. Thuraya phones and modems have been forwarded as a possible solution for the Central African region but we haven't seen one during our numerous field visits in DRC.

3.4 Software

Almost all of the end user computers run Microsoft Windows operating systems (XP, version 7 and 8) completed with Microsoft Office applications, with the exception of laptop computers in the University Teaching Hospitals of Kinshasa, Lubumbashi, Kisangani and Bukavu, which are running Ubuntu. Debian and Ubuntu operating systems also seem to be increasingly popular on MoH servers.

Although health specific software implementations remain rare, a clear tendency towards web-based business applications is being noted, often based on Linux/Apache, MySQL databases and PHP or Java development:

- The MOH started in 2014 pilot implementations of the DHIS2 data warehouse in Kinshasa and West Kasai as a replacement for the outdated MS Access based GESIS health data collection solution. Further extension of DHIS2 to the Maniema and Equator provinces was scheduled for end 2014 and by the end of 2016 all DRC provinces should be covered. Early DHIS2 deployments in DRC uncovered a list of technical and operational problems, many of them related to poor internet connectivity and unreliable offline data entry. These must be solved before national DHIS2 rollout can be successfully planned.

- iHRIS human resource information system deployment also started end 2014 with the first implementation pilots scheduled for the first quarter of 2015.
- Hospital information system (HIS) implementations remain exceptional (less than 2% of the hospitals), with 3 health university teaching facilities in our study sample running OpenClinic GA, 1 hospital running an alpha edition of BHIMA and 4 hospitals using different locally developed Microsoft Access or SQL Server based applications. The majority of the HIS solutions are concentrated in third level reference health facilities.
- Alfresco document management was installed at the central MoH level but is not yet being used in a production environment
- Joomla and Drupal seemed to be the most popular solutions for dynamic website content development (13 out of 14 sites or 93%)

Epi-Info and SPSS are the leading statistics software solutions at the central level, where CSPro also gained some popularity in remote structures.

General and analytical accounting systems are extremely scarce in the health sector structures of the DRC: Progi-Santé (local development), Account-Pro, Ciel Compta and SAGE are being used by a handful of health facilities while Tompro was recently introduced for project-oriented accounting at the central MoH level.

Software type	Central level	Intermediate & peripheral level
Operating systems	MS Windows (XP, 7, 8) Debian & Ubuntu Linux	MS Windows (XP, 7, 8) Debian Linux
Office applications	MS Office	MS Office Libre Office
Database servers	MySQL MS SQL Server	MySQL MS SQL Server
Statistics software	Epi-Info SPSS Epi-Data	Epi-Info CSPro SPSS STATA Epi-Data
Accounting	Ciel compta Tompro	Progi-santé Ciel compta Account-pro SAGE
HIS	OpenClinic GA OpenERP-Medical PPH	OpenClinic GA Gestion hospitalière BHIMA
Data warehouse	DHIS2	DHIS2 GESIS (exit strategy)
HR management	iHRIS	iHRIS
GIS	Epi-Info Maps Quantum GIS Healthmapper (WHO)	Epi-Info Maps Quantum GIS Healthmapper (WHO)
Planning software	GPSS WISN (WHO) Health Accounts Production Tool MS Project	CDMT
Content management	Joomla Drupal Alfresco	Joomla

Table 2. software systems identified

3.5 Paper based instruments

Only 2 of 11 provinces and some 30 health zones out of 516 are using ICT-tools for reporting health data to the central level, meaning that the vast majority of the MoH structures still rely on paper based instruments for routine data collection. Information is written down in registers by peripheral health center- or hospital staff and sent on a monthly basis to the health zone administration (emergency surveillance information is sometimes reported more quickly using SMS). Health zones then forward compiled health facility data to the provincial level, where eventually provincial reports are sent to the central level in Kinshasa.

A minimum of 32 registers must be kept up to date permanently by each health center. Additionally, donors and health intervention programs claim parallel and redundant reporting from the health facilities and zone administrations they support, which represents an impressive administrative overhead.

Paper based instruments are also predominant in the vast majority (98%) of the hospitals, which all suffer from low quality health information management.

3.6 Health information management problems detected

Over the past 10 years, the existing health sector ICT landscape of the DRC has been growing organically, with the majority of the project-oriented solutions being brought in by donors and health programs. This happened in an uncoordinated way, leading to:

- **Lack of standardization:** health information representation is hardly standardized and very few international classifications or coding systems are taken into account (with the exception of some of the DHIS2 and HIS modules).
- **Data availability risks:** many databases are hosted in donor countries outside DRC, with serious data accessibility risks for the MoH. Also, many MoH agents use personal computer equipment without appropriate backup procedures or anti-virus protection.
- **Data protection risks:** data access rights are not being formally organized according to the role that individual agents fulfil in the health administration; most often people have full access or no access at all to the information.
- **Poor data quality:** multiple reasons explain the poor quality of data collected in the field. There is (1) the lack of intrinsic motivation with MoH staff that don't produce data for their own purpose; (2) the important administrative burden caused by redundant health data collection processes; (3) the fact that many MoH agents don't have the necessary qualifications for producing reliable data; (4) the absence of personal consequences linked to the production of erroneous information; (5) donors often pay for project focused health data and compromise the global and systemic collection of data that is not linked to such financial benefits.
- **Poor data promptness:** the lack of reliable (electronic) communication instruments delays the transmission of health information between different levels of the health system.
- **Lack of data completeness:** data is still being considered a factor of power and the lack of perceived personal interest in information sharing interferes with effective and systematic communication of data in the health sector of the DRC.
- **Defective and insufficient computer equipment:** the vast majority of the MoH structures have no access to appropriate ICT hardware and due to the lack of maintenance procedures, many of the existing equipment has become defective. Computer virus infections also constitute a major problem for the MoH administration.
- **Inadequate ICT infrastructure:** today, access to stable electric power is out of reach for most of the MoH structures outside the larger cities. UPSs have been provided with most of the computers, but their batteries are often defective and don't provide any protection against power failures (in some regions, power failures can last for days, heavily compromising the reliability of electronics in every day's work). Affordable high bandwidth internet is unavailable for most of the MoH components. Donor project-funded internet connectivity is always limited in time and does rarely bring a sustainable solution.
- **Unregulated e-health market:** although e-health solutions are being considered "medical devices" by WHO, no standards or regulations have been put in place for bringing in ICT-tools in DRC's health system. E-Health solutions deployment therefore escapes today from any health authority control.
- **Lack of health applications:** most of the software solutions deployed in the health sector are generic office applications, statistical analysis applications or aggregate data reporting instruments. Very few health application implementations such as hospital-, laboratory-, radiology- or pharmacy information systems have found their way to the DRC's health system.
- **Insufficient human capacity:** human resources constitute a major problem for introducing e-health solutions in DRC: on the one hand, qualified staff who are capable of effectively using ICT-tools in their work environment are missing in most of the MoH structures. On the other hand, there is a plethora of unmotivated and unqualified (often pensionable) staff occupying positions in the MoH administration [13] preventing young and better qualified workers from being recruited. Additionally,

health-ICT related training and education opportunities are not aligned to the needs expressed by the different directorates and health facilities.

- **Organizational problems:** the organizational structure of the MoH reflects in no way the important transversal role of ICT in today's healthcare. The statute of ICT professionals of MoH is far from attractive, demonstrating the fact that they are considered an administrative burden rather than a valuable asset of the organization.
- **Ineffective dissemination of information:** the absence of a reliable communication network also heavily compromises the dissemination of regulations, good practice guidelines and policies from the central MoH level to the peripheral structures.

4 Discussion

This study enabled us to quantitatively and qualitatively estimate the status of health ICT tools deployment in RDC's health sector, based on a representative sample of administrative structures, health facilities, education- and research institutions. The output of the study has been used as a starting point for the further development of an e-Health Enterprise Architecture for DRC's MoH, of which a first draft was presented in Kinshasa on October 20th 2014 [12].

The study results more or less confirm the precarious situation of the Congolese health information system [1, 2, 13, 14], but they also expose a number of bright spots that provide hope for the future [16, 17]:

- There seems to be a political will to reclaim MoH leadership in the health information management domain by enforcing compliance with international consensus and standards for all future e-health initiatives, with the MoH in a regulator/gatekeeper position.
- The human resource deficit in health informatics is huge [13] and many of the country's education institutions will have to collaborate on national and international levels to provide necessary ICT training, undergraduate and postgraduate health informatics programs. The readiness to do so seems to exist on the side of the Congolese universities and the donor community [15, 17].
- Although DHIS2 pilot implementations have been facing numerous practical problems, most of the users involved in these pilots agree that a number of important steps forward have already been realized and none of them wishes to revert to paper based data collection.
- Hospital information management systems implementation has been successful in several hospitals (University Teaching Hospitals of Lubumbashi, Kisangani and Bukavu [15], Reference Hospitals of Kisantu, Monkole and Tshikaji) and provide clear evidence for the feasibility of HIS implementation in DRC [16].

The challenge remains to capitalize the experiences from the success stories and to integrate them in a new coordinated, well adapted and appropriately funded e-health strategy for the country in the next 5 to 10 years.

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Statement on conflicts of interest

None

References

- [1] National Plan for Health Development (PNDS 2011-2015), Ministry of Health, Kinshasa, DR Congo, March 2010
- [2] Health System Strengthening Strategy (SRSS), Ministry of Health, Kinshasa, DR Congo, June 2006
- [3] Strategic Plan for Hospital Reform (PSRH), Ministry of Health, Kinshasa, DR Congo, December 2010
- [4] PNDS Monitoring and Evaluation Framework, Ministry of Health, Kinshasa, DR Congo, August 2011
- [5] National Plan for the Development of Health Human Resources (PNDRHS), Ministry of Health, Kinshasa, DR Congo, March 2011
- [6] Strategic Plan for ICT in Health (draft), Cellule d'Information Stratégique, Ministry of Health, Kinshasa, DR Congo, April 2014
- [7] Stratégie de développement du secteur des télécommunications et des technologies de l'information et de la communication de la RDC, Ministère des Postes, Téléphones et Télécommunications de la RDC, Kinshasa, DR Congo June 2009
- [8] Recommandations sur la politique et les stratégies de développement des technologies d'information et de communication (technical note), Prime Ministers Office, May 2013
- [9] Arrêté ministériel (AM) n° 1250/CAB/MIN/BYY/PT/0005/2005, Ministry of Health, Kinshasa, DR Congo, March 2005
- [10] Cadre Organique du Ministère de la Santé Publique, Ministry of Health, Kinshasa, DR Congo, August 2012
- [11] The Open Group Architecture Framework (TOGAF), <http://www.opengroup.org/togaf/>
- [12] Verbeke F, Shamashanga P, Amisi C, Karara G, National Plan for Health Informatics Development in DRC (PNDIS), Technical report, CEDESURK, Kinshasa, DR Congo, October 2014, ISBN 978-99951-69-03-7
- [13] Human resources for health: overcoming the crisis. WHO; 2004. Available from: http://www.who.int/hrh/documents/JLi_hrh_report.pdf
- [14] Kruse S-E. Health Information Systems in Africa: Resources, Indicators, Data Management, Dissemination and Use. Technical papers. Algiers: Centre for Health and Social Development (HeSo); 2008. Available from: <http://www.tropika.net/specials/algiers2008/technical-reviews/paper-8-en.pdf>
- [15] Nyssen M, Verbeke F, Bakasanda O, Rémon M. Eb@lé-Santé: introducing electronic health records in RDC. ICIA 2011 Conference Papers. Canaan Land, Nigeria: ICIA; 2011. Available from: <http://www.fichier-pdf.fr/2011/07/15/introducing-electronic-health-records-in-democratic-republic-of-congo/introducing-electronic-health-records-in-democratic-republic-of-congo.pdf>
- [16] Kamadjeu RM, Tapang EM, Moluh RN. Designing and implementing an electronic health record system in primary care practice in sub-Saharan Africa: a case study from Cameroon. *Informatics in primary care*. 2005;2005(13):179–86.
- [17] Verbeke F, Karara G, Nyssen M, Evaluating the Impact of ICT-tools on Health Care Delivery in Sub-Saharan Hospitals, *Stud Health Technol Inform*, August 22, 2013

Peer-performance review as a strategy for strengthening health information systems: a case study from Ghana

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Background and Purpose: The Ghana Health Service (GHS) in 2012 embarked on an ambitious programme to improve its health information system (HIS) in order to improve upon healthcare delivery and also to meet the health related millennium development goals (MDGs). This resulted in nation-wide implementation of the District Health Information Management System (DHIMS2), software based on the District Health Information Software (DHIS2), in all its facilities and some private and quasi government health facilities. The DHIMS2 is the Ghanaian version of the global DHIS2 software developed by the University of Oslo.

Methods: As part of its mandate the GHS holds periodic peer reviews meetings at different levels of its structure as a mechanism for measuring service performance in order to identify service gaps that will lead to interventions to improving the coverage and quality of service to its client. This paper is a qualitative assessment of the DHIS2 software based on specified criteria from some of these review meetings in selected regions towards achieving the set goals. The paper will look at the status quo with respect to infrastructure, resources in general, human resource, stakeholder involvement, data quality and data use since the implementation of the DHIS2 project in Ghana. Data collection and analysis was qualitative using participant observation, focused group discussions, semi-structured interviews and document analysis.

Results: Our research has shown that the GHS has successfully implemented an integrated and sustainable web-based HIS. Data quality in all aspects has been improved through institutional arrangements such as peer-performance reviews using DHIS2 data and establishment of data quality assurance teams at all levels. This implicitly has promoted data use for decision making. The online system has also ensured data transparency and accessibility. 'Break-downs' in the system such as lack of funds, faulty equipment, lack of adequate and skilled human resource for data management is seen as some major challenges to data quality. Such 'break-downs' may also be seen as opportunity for system strengthening and sustainability as end-users are compelled to use personal resources for managing data. Through institutionalized peer-performance review processes using data from the DHIS2 is improving the quality of health service data for planning and decision making.

Conclusions: This research has demonstrated that with the right technology, policy and collaboration from interested stakeholders it is possible to implement a sustainable HIS in developing countries such as Ghana. We have also shown that institutionalized arrangements for data use has significantly improved the quality of service data generated which will aid planning and decision-making

Keywords: Health information system, Data quality, Data use, Peer review

1 Introduction

In 2011 the Ghana Health Services (GHS) adopted the web based and open source DHIS2 software developed by the global HISP network and coordinated by the University of Oslo [1] With technical support from the university of Oslo and financial support from stakeholders, the GHS in 2012 successfully implemented DHIS2 dubbed District Health Information Management System (DHIMS2) nation-wide. The software is now being used in all districts offices, government, some private, faith based

and quasi government hospitals. The system requires a computer, a browser and internet connection to implement. Country-wide implementation has been made possible due to telecommunication boom in Ghana especially mobile telecommunication and taking a cue from similar implementation strategy by Kenya which was the first country in Africa [2] to have implemented HMIS online.

As part of its mandate all GHS facilities and Budget Management Centres (BMCs) are expected to account for their stewardship at half year and annual reviews. Administratively new districts have been created from existing ones giving a total number of 216 districts as against about 160 at the onset of the project. In this article we describe and discuss the DHIS2 implementation in Ghana focusing on the summary findings of the review meetings and the use and evaluation of DHIS2 data during this process.

2 Materials and methods

This project was conceived as a node in the HISP global network. The research tradition among the HISP Global Infrastructure (GI) group to which the authors belong, draw on the Scandinavian Action Research (AR) tradition in information systems (IS) development where user participation, evolutionary approaches, and prototyping are cornerstones. By definition AR is a qualitative research method where the researcher is actively involved in solving a real-world problem by introducing change in an organization, while at the same time contributing to knowledge and theory [7, 8, 9, 12, and 13]. AR is embedded with cyclical process model that encapsulate project management and system development cycle. The steps in developing a client system infrastructure (i.e.DHIS2) under canonical AR include diagnoses of perceived problem, action planning, action taking, (monitoring) evaluation and knowledge specification [8]. The cycle is repeated for knowledge refinement, otherwise it is exited.

The DHIS2 project is much more than a technical software project. It includes capacity building oriented towards specific requirements from the health sector that need to be incorporated into system development, end-user support and training in data quality assessment and data use for decision making. Many studies in HIS development have also emphasized on the need to also focus on the non-technical issues in system development cycle and long term system ‘life-cycle’ approach in order to ensure sustainability [18, 19, 20, and 21]. In the same vein the strategic objective of the HISP network and the DHIS2 project is to support the development and sustainability of a robust HIS that will enable health workers to generate and use health data for quality healthcare delivery [1, 2, 17].

Each of the authors have been fully involved at various stages of the implementation of this system, from its inception and design in 2010 through to the live nationwide rollout in 2012 and subsequent settling into the maintenance and evolution cycle of the production system. They have also participated in the review meetings at various levels and believe that by reviewing and assessing the challenges and successes they have experienced to get a web-based system functioning, useful lessons could be learnt for the success of similar efforts elsewhere in Africa.

Data collection was through participation in the annual review processes and other meetings, participant observations, discussions, interviews and analysis of documents. Interviews were interactive and were used in an attempt to have a deeper understanding of the phenomenon under study and to obtain information on the impact of DHIS2 implementation on the review processes with respect to provision of quality healthcare [3]. For the period of two years a total of 91 interviews and 4 focus group discussions were conducted. The participants in the interviews and focus group discussions included National Divisional/Programme Heads, District Directors of Health Services (DDHS), Regional Directors of Health Services (RDHS), health facility heads, Public Health Nurses (PHN), Disease Control Officers (DCO), Health Information Officers (HIO) and Biostatistics Officers (BSO). Informal discussions were also held with peers, stakeholders and national representatives regarding emerging trends in HMIS in the GHS.

3 Results

3.1 The Review Process

The annual review process starts at the level of BMC. This involves an internal review of BMC performance based on their annual plans, targets and achievement over the period. This is done at the facility, district, regional and national culminating in the Senior Managers' Meeting (SMM) within the first quarter of the ensuing year to review regional and national performance through a series of regional and divisional presentations. This forms the basis for the development of the GHS Annual Report. It was instructed that data from the DHIS2 should be used for the peer-performance reviews.

The assessment of the DHIS2 software was done at different levels taking into consideration certain key characteristics having direct impact on the quality of service data. Broadly speaking the assessment looked at sustainability of the DHIS2 project with respect to technical infrastructure, resources, human resources, stakeholder involvement, data quality and data use

3.2 Human Resource

Every health staff involved in managing data was trained during DHIS2 implementation. Traditionally it was the responsibility of the HIO or the statistician at a given BMC to see to all issues concerning data. With the introduction of DHIS2, programme officers were trained to enter their own data into the system. The rationale was that the disease control officer, public health nurse, nutrition officer, surveillance officer, etc. will make few mistakes when he keys in his own data because he understands his own data better than another person. It was observed that in districts where there has not been any change in the staff situation there has been remarkable improvement in all aspects of data quality in terms of completeness, accuracy, timeliness and consistency.

In some districts the situation is however different due to a number of reasons. Initially the DHIS2 was designed with a minimum number of datasets which has been increasing steadily over the years as other divisions/departments and stakeholders came on-board. In situations where only the HIOs were responsible for data management there were challenges with some aspects of data quality due to work load. It was also observed that for some districts data quality was affected due to either no HIO or data officers leaving for further studies with no replacement. When a DDHS was asked why there has not been a replacement of his HIO when he went to school the response was....

'the HIOs are simply not available....our HIOs training schools do not produce enough to satisfy their increasing demand in the service...it will take some time to bridge this very important gap..'

Another general concern identified was the lack of retraining on the DHIS2 new versions and more generally training on its data analysis functionality. Since the implementation and national training in 2011 to 2012, there has not been any serious retraining of data officers. Meanwhile new versions with completely new features are released every quarter. The reason for this gap was lack of funds as it requires huge amounts to do such national trainings. End users are therefore reluctant to explore the new features in the software for fear of corrupting the system. One public health nurse commented that...

'I manage to get my data in the system so that my director will not tell me I am not working...for analysis I have a way of getting my data into excel where I can plot my graphs and draw my charts...'

This is a complete inefficient use of the software since it has all the basic modules for data analysis and the import is that this officer might not be alone in underutilizing the system.

3.3 Data Quality Improvement

An important objective of the DHIS2 project is to improve the quality of service data for decision-making. In addition to inbuilt system checks which are technically called validation rules, there are also institutional arrangements to ensure that all BMCs improve the quality of data captured. BMCs are expected to have functional data validation teams which meet monthly to validate the data generated before input into DHIS2. Compared to the previous year it was observed that BMCs are beginning to see the importance of validation meetings as evident from the statistics in their presentations and increases in coverages in targets set for the year i.e. 10-12 validation meetings in 2013 as compared to nil to below 5 meetings in 2012; average data completeness of above 70%, etc. as in Figure 1. Unlike in previous years where there were no validation teams in some BMCs or where they exist they were not functional, the observation was that currently most BMCs have a functional data validation teams.

REGIONS	PERCENTAGE TIMELINESS	REGIONAL POSTION	REGIONS	PERCENTAGE Average Completeness	REGIONAL POSTION
Brong Ahafo	54.7	1 st	Brong Ahafo	94.2	1 ST
Ashanti	50.2	2 nd	Upper East	88.6	5 th
Upper East	49.1	3 rd	Volta	93.1	3 rd
Volta	45	4 th	Western	86.1	8 TH
Eastern	40.1	5 th	Ashanti	82.9	9 TH
Western	38.1	6 th	Upper West	95.7	2 nd
Upper W	37.4	7 th	Central	87.3	7 TH
Central	35	8 th	Greater Accra	90.9	4 th
Greater Accra	28.9	9 th	Eastern	88.3	6 TH
Northern	27.3	10 th	Northern	71.8	10 TH
			GHANA	87.9	

Figure 1. Regional league table on aspects of data quality (timeliness and completeness)

Routinely regional validation teams meet every month to look at the regional data based on data completeness, timelines, accuracy and consistency. In addition technical supervisory visits that validate data in the DHIS2 and compares this to what is in the facility registers are also organized quarterly. These institutional arrangements have seen increases in coverages evident from three year trends in BMC presentations at the annual performance reviews attended. There has also been institutionalization of monthly to quarterly league table for districts for selected indicators thus fostering healthy competition among districts to endeavour to improve upon the quality of their data. It was however observed that districts were not able to foster such keen competition among facilities in their districts. When HIOs were asked why this was not possible the response was work overload in most cases and lack of HIOs in some of the districts.

3.4 Data Use

The GHS has established processes that promote data use. The half year and annual performance reviews strengthens data use by setting targets and making decisions. For example as shown in Figure 2 by institutionalizing peer-performance reviews, establishment of functional Data Quality Assurance (DQA) teams at all BMCs and quarterly integrated monitoring and support visits has led to significant improvement in all aspects of data quality.

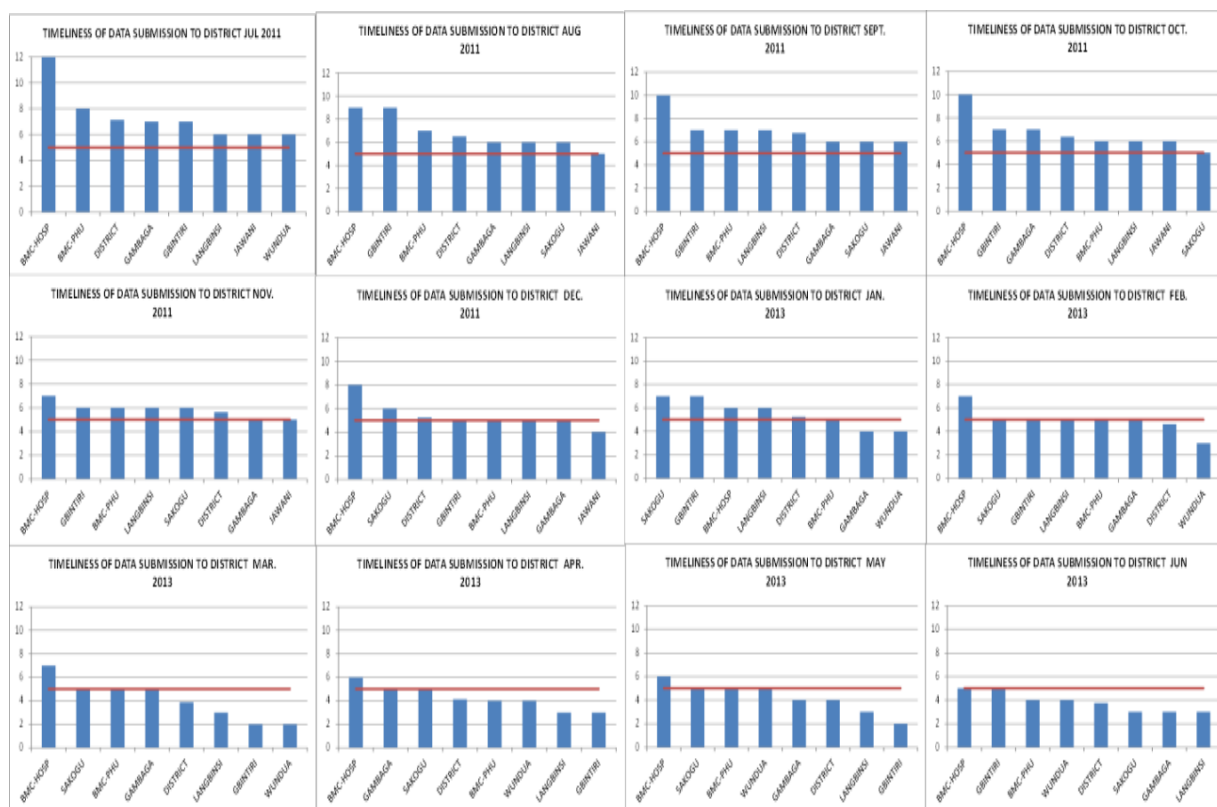


Figure 2. A three year trend (2011-2013) of timeliness of data submission. The red line is the target of which either equal to or below signify timely submission of data by districts.

Across all levels league tables are often used to show the performance of BMCs on components of data quality (completeness, timeliness, accuracy and consistency) or the performance of selected indicators at some level. Figure 1 for instance shows a national league table comparing the average rate of submission of all datasets in the DHIS2 by regions and the average rate of data completeness in terms of expected number of datasets to be reported on against the actual by regions. In the same vein Figure 3 also shows a trend line for percentage accuracy of ANC 4th visits in selected health facilities. Accuracy is calculated from the number of ANC 4th visits on either the summary sheet or in the DHIS2 against the number in the ANC Register which is the original source. As clearly shown in the graph reporting on ANC 4th visits in the selected health facilities have significantly improved towards the golden standard (100%) since the implementation of the DHIS2.

It is also mandated that all BMCs under the GHS use DHIS2 data at peer-performance reviews and for planning. Initially it was difficult to enforce such a policy due to the existence of parallel systems owned by well-resourced and powerful programmes such as TB, HIV/AIDS, Malaria, etc. From the recent reviews attended it was clear that the situation is changing since almost all these special programmes are now part of the DHIS2 project, at least with their aggregated data. It was interesting to see peers challenging each other as to the source of any spurious data if the data presented does not correspond to that in the DHIS2 which was instantly quoted or projected for all to see.

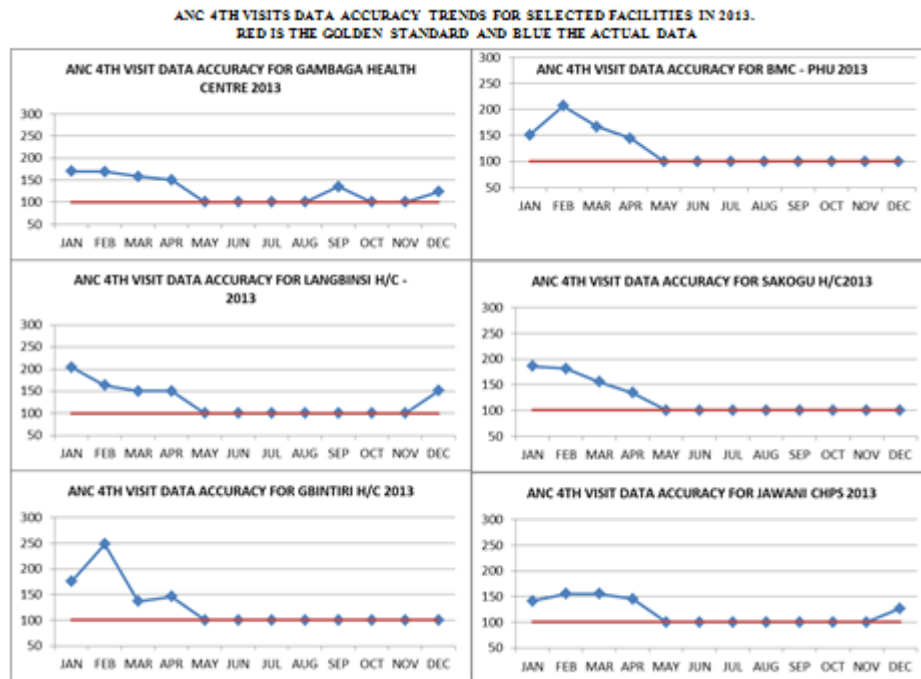


Figure 3. Trend analysis of data accuracy for selected health facilities in 2013

3.5 Resources and Challenges

As remarked by one DDHS... 'It takes resources to collect data to generate information for decision making...without resources how is one expected to work?' This sums up the situation two years after the implementation of the DHIS2. Before the project started the GHS and its stakeholders ensured that all districts offices and hospitals were equipped with the requisite resources to enable them collect and manage health service data, i.e. computers, mobile modems, funds for data packages, etc. The observation has been that some of this equipment has broken down and have not been repaired or replaced due to unavailability of funds. Where the equipment is functioning it is becoming increasingly difficult to purchase data packages or pay for internet services for data management. Many officers we interviewed complained bitterly for using their own resources both financially and materially to collect and manage service data.

Administratively new districts have been created from existing ones giving a total number of 216 districts as against about 160 at the onset of the project. It was noted that some of these newly created districts have not been adequately resourced to enable them collate, analyse and report on service data. Affected districts have to either rely on national or regional/provincial or neighbouring districts for support leading to gaps in their respective data. One district officer remarked...

'since we were created as a district we have not been given any resources to run the district office....I use my own lap top for data entry and analysis ...otherwise I will have to take my returns to the regional office for input which also incur transportation cost which nobody will pay for..'

4 Discussion

The study findings have demonstrated that reporting rate and timeliness have improved after the implementation of the online DHIS2 system. The study has also shown that active use of data from the DHIS2 during the review process both at district and regional levels as well as the increase in data validation activities documented at the BMC level, demonstrate that the use of data is increasing. Increase

in data use and local validation will necessarily also lead to increased data quality. The online data system has drastically improved the access to data, which again has led to improved data use.

The process of developing and implementing information systems in developing countries is a challenging task [4] [5] [6] due to poor technical infrastructure, inadequate skilled human resources and lack of funds. This study has shown that similar challenges are also found in Ghana. Lack of funding for training, airtime and data packages for internet connection and replacement of broken equipment represent real challenges. We have also seen that the answers to such challenges have been, for example, end-users using their own equipment, money for internet packages and transport to central locations in order to access the system. This is indicative that the end-users find the system useful and that a sense of 'ownership' is being developed, which again may help ensure sustainability.

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Statement on conflicts of interest

The authors would like to state that there have not been any conflicts of interest in the conduct of this study.

References

- [1] Braa, J., Hanseth, O., Mohammed, W., Heywood, A., & Shaw, V. (2007). Developing Health Information Systems in Developing Countries. The "Flexible Standards" Strategy. *MIS Quarterly*, 31.
- [2] Kossi, Edem Kwame, Johan Ivar Sæbø, Jørn Braa, Mohamed Mumeneh Jalloh, and Ayub Many. Developing Decentralised Health Information Systems in Developing Countries –Cases From Sierra Leone and Kenya. *The Journal of Community Informatics*. 2012;9(2)
- [3] Kvale, S., (2009). *Learning the Craft of Qualitative Research Interviewing*. Sage Publication Inc.
- [4] Heeks, R., Mundy, D., & Salazar, A. (1999a). *Why Health Care Information Systems Succeed or Fail: University of Manchester*.
- [5] Heeks, R. (2002). Information Systems and Developing Countries: Failure, Success, and Local Improvisation. *The Information Society*, 18, 101-112.
- [6] Avgerou, C. (2002). *Information systems and global diversity* (Vol. 1). Oxford: Oxford University Press
- Bødker, S., Ehn, P., Knudsen, J. L., Kyng, M., & Madsen, K. (1988). *Computer support for cooperative design (invited paper)*. Paper presented at the Proceedings of the 1988 ACM conference on Computer-supported cooperative work, Portland, Oregon, United States.
- [7] Avison, D., Lau, F., Myers, M. D., & Nielsen, P. A. (1999). Action Research. *Communications of the ACM*, 42(1), 94-97.
- [8] Baskerville, R. L. (1999). Investigating information systems with action research. *Communications of the AIS*, 2(3es), 4.
- [9] Baskerville, R. L., & Wood-Harper, A. T. (2002). A Critical Perspective on Action Research as a Method for Information Systems Research In M. D. Myers & D. Avison (Eds.), *Qualitative Research in Information Systems* (pp. 129-145): Sage Publications.
- [10] Klein, H. K., & Myers, M. D. (1999). A set of principles for conducting and evaluating interpretive field studies in information systems. *MIS Quarterly*, 23(1), 67-93. doi: 10.2307/249410
- [11] Baskerville, R. L. (1997). Distinguishing action research from participative case studies. *Journal of Systems and Information Technology*, 1(1), 24-43.
- [12] Susman, Gerald I, and Evered, Roger. An Assessment of the Scientific Merits of Action Research. *Administrative Science Quarterly*. 1978;23(4):582–603.
- [13] Braa, Jørn, Eric Monteiro, and Sundeep Sahay. Networks of Action: Sustainable Health Information Systems Across Developing Countries. *Management Information Systems Quarterly*. 2004;28(3):337–362.
- [14] Orlikowski, W., & Baroudi, J. J. (1991). Studying Information Technology in Organizations: Research Approaches and Assumptions. *Information Systems Research*, 2(1).
- [15] Walsham, G. (1995). Interpretive case studies in IS research: nature and method. *European Journal of Information Systems*(4), 74-81.

- [16] Miles, M.B. and Huberman, A.M. (1994) *Qualitative Data Analysis*, Thousand Oaks:Sage Publications
- [17] Shaw, Vincent (2005). Health information System Reform in South Africa: Developing an Essential Data set. *Bulletin of the World Health Organization* | August 2005, 83 (8)
- [18] Leonor Teixeira Santos, C. BS (2012) User-centered Requirements Engineering in Health Information Systems. A Study in the Hemophilia Field. *Computer Methods Programs Biomed* 106(3):160–74
- [19] Fu Y, Li M, Chen F (2012) Impact Propagation and Risk Assessment of Requirement Changes for Software Development Projects Based on Design Structure Matrix. *Int J Proj Manag* 30(3):363–373.
- [20] Jui-Jen Chen, Wu-Chen Su, Pei-Wen Wang and Hung-Chi Yen (2013) A CMMI-based Approach for Medical Software Project Life Cycle Study <http://www.springerplus.com/content/2/1/266>
- [21] Magdaleno AM, Werner CML, Araujo RM (2012) Reconciling Software Development Models: a Quasi-systematic Review. *J Syst Softw* 85(2):351–369



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When information technology meets healthcare in West Africa: a literature review

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Introduction: This paper presents the study and analysis of some articles that were selected according to their potential contributions to the introduction of information technology (IT) in the Healthcare industry in West Africa. A total of nineteen papers published in various journals were analysed after their titles and abstracts were reviewed.

Objective: The aim of this paper is to find out on how the introduction of information technology can transform the healthcare delivery in West Africa.

Methods: Keywords were used to select online articles that focus on the ways in which the use of information technology has improved or is yet to improve the provision of better healthcare in West Africa.

Results and Conclusions: Information technology has a very bright future for healthcare managers, practitioners and the industry as a whole in West Africa when all the known challenges either politically-based or economy-based are removed.

Keywords: Health Information Systems (HIS), Healthcare, Information Technology (IT), West Africa.

1 Introduction

Healthcare in Africa is faced many challenges that prevent its efficiency and effectiveness. Most of these problems are brought about by the fact that the African continent is still advancing in terms of modernity and informatics tools. These are specifically designed to assist those clinicians and healthcare professionals who provide the majority of patient care in non-academic medical settings. Such advancements could have a tremendous impact on improving healthcare quality as well Ogunyemi et al, (2010) [15]. One of the main impediments to proper healthcare in West Africa is lack of exposure to readily available healthcare information systems. This goes along with the fact that most of the population up to date is not educated and thus there is a lack of health care information about how they can improve their own health by receiving the proper healthcare delivery services.

Developing countries in Africa suffer from shortage of well-trained healthcare providers and brain drain of health professionals. According to Fraser and McGrath (2000) [9], there are approximately ten doctors per 100,000 people which may vary from country to country. In some countries in Sub-Saharan Africa (SSA) the healthcare workers serving the population are distant away from them. Others do not either have well-trained radiologist or out-dated X-ray, computer axial tomography (CAT), and magnetic

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resonance imaging (MRI) machines. SSA is simultaneously faced with a shortage of doctors and other professionals. Mbarika et al (2005) [13] after five years confirm that the continent has even fewer than 10 doctors per 100,000 people, and fourteen of its countries do not have a single radiologist, which is sad compared to the developed countries. People also lack access to up-to-date healthcare information due to poor roads and expensive Internet facilities in rural areas as well as scarce of library facilities in those areas.

This paper reviews current papers on Medical Informatics and IT in health care in order to:

- give an overview on some important solutions and current research projects in West Africa and
- describe a collection of most important specific requirements on IT-support for health care in West-Africa.

2 Materials Used

Articles that were selected were those that focused on the ways in which the use of modern technology has improved or is yet to improve the provision of better healthcare in West Africa. The articles were mostly restricted to OpenAccess Papers and have been written by scholars and have been peer reviewed because they are more likely to carry equally accurate information. Search engines such as Google scholar, Microsoft Academic and Yahoo searches were used to achieve a broad overview on related articles even if they are not referenced in PubMed. We wanted also to experiment literature review outside PubMed, which would have been a better source, because access to well-known international journals is limited especially in West African. Sites such as jstor.com that contain scholarly articles were also used with one article from MEDINFO.

Once the articles showed up on the search engines using keywords like health information systems, healthcare, information technology, electronic prescription, digital radiology, e-health and West Africa, their contents were carefully scrutinized to ensure that those with the most accurate information were selected. Priority was given mostly to those that were written within the past seven years. This is because topics that involve technology are quite sensitive given that technology changes rapidly in the current world.

3 Results

3.1 Communication Technology

The Internet has quickly found a way to navigate and penetrate Africa in the past few years. Currently, it is easily available in most, if not all parts of the continent, Benson (2011) [3]. This has enabled the people to access free information for example by online journals, books and articles that contain the information they are searching. These Internet services are also easier to use because they are much cheaper and readily available than the traditional ways of acquiring information. As long as one has good access to the Internet, everything else becomes almost if not absolutely free. SatelLife is one of the organizations that have taken advantage of the Internet availability in Africa to assist in alleviating their healthcare problems, Idowu, (2008) [11]

It is again noticed that the problem that is eating away proper healthcare in Africa is the lack of consistent and reliable channels of communication between patients, healthcare providers and any other healthcare stakeholders, Zurovac et al (2012) [21]. Therefore, the emergence and quick spread of mobile handsets may provide a long-term solution. Text messaging is one of the e-services that are likely to be used most on these gadgets. This is because they are easy to use, cheap and are available on all types of mobile phones and other mobile devices like the electronic tablets used in surveillance and in assisting the patients to be more consistent with treatment and seeking further treatment when required.

Additionally, how reproductive health workers are using information technology to perform their jobs is also analysed, Olatokun & Adeboyejo (2009) [16]. They have recently adopted video conferencing as a method of communication amongst themselves. E-mails are the most used electronic mode of communication among these practitioners because they find it cheap, quick, free and quite easy to use. Although through this means of communication, the parties involved are not able to interact on face to face or in real time, it has proven fundamental in the provision of information, especially when it is urgent, within a short time. Users normally praised ICT for having aided them in easy access to medical information. However, this sector still faces several challenges that can be blamed on economic and leadership problems, despite the people's willingness to embrace technology.

3.2 Digital Radiology

At large the African continent in general again suffers from inability to access to radiological assistance. A technology that plays a critical role in the management of many acute and chronic diseases and eliminates the need for film development and processing, being simpler to use, and enabling instant reporting via teleradiology. This, however, would be overcome through various projects like the Institute for Maternal and Child Health IRCCS Burlo Garofolo supporting the Hospital Divina Providencia (HDP) in Angola since 2001 serving a population of about 1 million, in the suburbs of Luanda, Zennaro, et al, (2013) [20]. Interventions like these will oversee the use of digital images, which may still be availed to less people because of its high costs involved. Laser film scanners, which are a little too costly, can be replaced by consumer image scanners, which may be more affordable, but may provide less than perfect images. Medical practitioners are therefore thinking about the option of taking x-rays and transmitting them by taking digital images of them for sending, Zurovac (2012) [21]. This may still prove a challenge when quality is being short, but can be effective when the medics that are handling these images are well trained and able to see through the imperfect pictures.

3.3 Electronic Prescription

With the introduction of technology in the healthcare services in West Africa products and service like the electronic prescription (e-prescription) could boost health delivery services. Such services enable improving the quality of the scripting process and reduce prescription errors and preventable adverse drug events. Above all, e-prescriptions are also easy to read and can thus be processed quickly by pharmacists, Cohen et al, (2013) [6]. The e-prescription would be instrumental in reducing the situation where patients become responsible for guarding the privacy of their prescription information while such information is in transit to the prescriber from the dispensing office. In addition, the inception of e-prescription would reduce the cost of drugs prescribed.

3.4 E-Health and Mobile Technology

Information systems, such as electronic health records (EHRs) and mobile phones and hand-held computers (also called m-health), can be of enormous value in providing health care in multiple settings. They can support a health worker performing clinician duties where there are no doctors and can help keep track of patients, Blaya et al, (2010) [4]. This initiative is geared towards the provision of medical tools and information to parts of countries where they are rather scarce. This could be done in collaboration with other health stakeholders in such countries such as the government, NGOs, and other private health agencies and is meant to improve access to better healthcare with technology, Korpela, (1994) [12].

The penetration of technology such as mobile phones has proven to be a good thing to the continent as it has been found fundamental in the delivery of quality this e-health care. These electronic devices have made it easier for medical practitioners to avail medical information and resources even in areas that are hit by serious shortage of qualified medical practitioners.

Pakenham-Walsh and Bukachi (2009) [18] recognize the impediments to proper healthcare that are brought about by illiteracy and lack of information regarding access and use of proper healthcare information. This problem is existent in the public and sadly, among health practitioners as well. These health practitioners are unable to correctly diagnose and provide correct treatment for many diseases. This means that the healthcare they are able to provide becomes insufficient and ineffective, thus the masses continue to perish under circumstances that may have otherwise been avoided. They therefore suggest that there is need for close attention to be given to provision of better education and training to this group of people to ensure that they are well equipped to provide the necessary healthcare.

3.5 General Information System

A study that analyses the changes that information systems have brought to the continent in relation to provision of better healthcare in West Africa has been undertaken. The study cites a study that revealed the significance of technology in the management of renal diseases, Clifford et al (2008) [5]. However, they state that it is important for more improvements to be made to these services to realize even better outcomes.

On the other hand Rotich et al (2003) [19] recognize the need to implement electronic patient records system in African hospitals, precisely those in the sub-Saharan section. This would go a long way to improve patient safety by ensuring that patient records are up to date, kept in safe modes, and much easier to access, thus improving the general quality of healthcare delivery in these countries.

Similarly, Odusote, K. et al, (2012) [14] echoed that the West African Health Organization (WAHO) is aimed at improving the population's access to quality health care by implementing a regional approach to strengthening human resources information system (HRIS). By this, WAHO works to improve health in the region by harmonizing policies and pooling resources of Economic Community of West African States (ECOWAS) member countries. Upon this, WAHO has coordinated a regional training on national health information systems given jointly by CapacityPlus's iHRIS team and two "sister" open source software projects, DHIS 2 and OpenMRS. DHIS 2 is the recognized global standard for open source disease surveillance and service statistics; while OpenMRS is the most widely-adopted open source medical records system in developing countries for better health care delivery.

This interoperability system allows for ease of communication among several branches of healthcare services delivery such as patient management, human resource management and laboratory test results et cetera. Eleven countries in West Africa are already rolling out this program, having already received the necessary training and attended workshops that aimed at improving the availability and efficiency of these systems.

Additionally, Pakenham-Walsh and Bukachi (2009) [18] analysed the needs of developing countries regarding health care delivery. The study opens that many health care workers have little or no access to basic, practical information in developing countries with attempts of information needs of primary and district health care providers. The study attributed this to several factors, including unequal distribution of Internet connectivity, and also a failure of international "information for development" policies and initiatives. However access to information is one of the main factors that should be looked into if these countries intend to have access to better healthcare delivery. Information technology has the potential to improving of healthcare delivery through better provision of information.

Acheampong (2012) [1] also recognizes the milestones that Ghana has undergone in the use of information technology in healthcare delivery and upholding the quality of life. This has been largely aided by the availability of cheap resources that facilitate projects geared towards improving efficiency of healthcare providers and exploitation of opportunities for improving healthcare. He however recognizes one of the major challenges to effective use of ICT in the health sector. This, he says is the scarcity of computers and Internet to those who are not wealthy.

4 Limitation

The biggest impediment that was met during this selection of publications was finding articles that exclusively talked about healthcare and technology in West Africa. Most of them were about the same topic but in the large sub Saharan Africa. Those that handled West Africa put too much emphasis on one country like Nigeria. This is a little misleading because they do not give us the true picture of the whole region as is required.

5 Conclusion

Health managers and practitioners in West Africa seem very willing to embrace ICT in service delivery. Unfortunately, the challenges that they are still facing are not solvable by them since they are political or economy based. Another problem that seems still far from a solution is illiteracy. It would be difficult for IT to be embraced and used effectively due to illiteracy. Poverty is the third major problem that may have to be dealt with before the region can truly enjoy the benefits of incorporating ICT into the healthcare system. This is because it makes it extremely difficult for the common people to have easy access to such technology that may aid them in acquisition of better health.

The most important lesson originates from the developments in adoption of national health information systems in most of these West African countries due to political instabilities and changes in government resulting from the practice of democracy.

Notwithstanding all these challenges, developed countries have seen rapid headway in health information technology despite the differences in architecture, infrastructure and facilities. It is and would therefore be useful for West African countries to unearth some valuable lessons especially those that are trying to gain full benefits of health information technology for the delivery of healthcare services.

In meeting the need to integrate trusted IT solutions with healthcare in West Africa for long-term patient quality and safety we propose the following requirements to include:

- the need for political and economic stability in these countries;
- the need for improved level of literacy;
- the need for workforce and its training needed to most effectively implement HIT systems;
- adherence to standards and interoperability, and concerns about privacy and confidentiality;
- to close the gap between of return on investment between those who pay and those who benefit from such services, Hersh and Wright, (2008) [10].

These requirements would likely lead to the provision of improved quality of care and reduction of associated risks of care like medication errors and delay in service provision with some amount of proof of associated savings of time or money.

In spite of the above requirements there have been a number of important IT health solutions in the African continent. Some of them worth knowing are:

- the Institute for Maternal and Child Health IRCCS Burlo Garofolo supporting the Hospital Divina Providencia (HDP) in Angola, Zennaro, (2013) [20],
- the 1998 teleradiology project connecting two secondary KwaZulu-Natal hospitals' radiography departments to a central Durban teaching hospital, Corr (1998) [7],
- the CellPhones4HIV in South Africa, Benjamin, (2010) [2] and
- The mPedigree Network, based in Ghana, lets people determine with a text message whether their medicine is legitimate. Talbot, (2013) [17]

6 Discussion

Emphasize the new and important aspects of the study and the conclusions that follow from them in the context of the totality of the best available evidence. Do not repeat in detail data or other information given in the Introduction or the Results section. For experimental studies, it is useful to begin the discussion by briefly summarizing the main findings, then explore possible mechanisms or explanations for these findings, compare and contrast the results with other relevant studies, state the limitations of the study, and explore the implications of the findings for future research and for clinical practice.

Link the conclusions with the goals of the study but avoid unqualified statements and conclusions not adequately supported by the data. In particular, avoid making statements on economic benefits and costs unless the manuscript includes the appropriate economic data and analyses. Avoid claiming priority or alluding to work that has not been completed. State new hypotheses when warranted, but label them clearly as such.

References

- [1] Achampong EK, "The State of Information and Communication Technology and Health Informatics in Ghana." *Online journal of public health informatics*; 4.2, (2012). pp 1-18
- [2] Benjamin, P. (2010). Cellphones 4 HIV. mHealth potential in South Africa: The Experience of Cell-Life, http://www.cell-life.org/images/downloads/Cell-Life_Organisation_Poster.pdf (accessed 2010).
- [3] Benson MB, DHA AC, "Hospital Information Systems in Nigeria: A Review of Literature." *The Journal of Global Health Care Systems*; 1.3, (2011). Pp 1 -26.
- [4] Blaya JA, Fraser HSF, Holt B, "E-health technologies show promise in developing countries." *Health Affairs* 29.2 (2010): 244-251.
- [5] Clifford, GD., et al. "Medical information systems: A foundation for healthcare technologies in developing countries." *BioMedical Engineering OnLine* 7.1 (2008): 18.
- [6] Cohen J, Bancillon JM, Jones M, "South African physicians' acceptance of e-prescribing technology: an empirical test of a modified UTAUT model." *South African Computer Journal* 50 (2013): 43-54.
- [7] Corr P, "Teleradiology in KwaZulu-Natal." *S Afr Med J* 88 (1998): 48-49.
- [8] Datta P, et al. "The neglected continent of IS research: A research agenda for sub-Saharan Africa." *Journal of the Association for Information Systems*; 6.5 (2005): 6.
- [9] Fraser HSF, McGrath SJD. "Information technology and telemedicine in sub-Saharan Africa." *Bmj* 321.7259 (2000): 465-466.
- [10] Hersh W, Wright A "What Workforce is Needed to Implement the Health Information Technology Agenda? Analysis from the HIMSS Analytics™ Database." *AMIA Annual Symposium Proceedings*. Vol. 2008. American Medical Informatics Association, 2008.
- [11] Idowu P, Cornford D, Bastin L, "Health informatics deployment in Nigeria." *Journal of Health Informatics in Developing Countries*; 2.1 (2008).
- [12] Korpela M, *Nigerian practice in computer systems development: A multidisciplinary theoretical framework, applied to health informatics*. Helsinki University of Technology, 1994.
- [13] Mbarika, V. W. A., Okoli, C., Byrd, T. A. and Datta, P. (2005) The Neglected Continent of IS Research: A Research Agenda for Sub-Saharan Africa. *Journal of the Association for Information Systems*, Vol. 6, No.5, pp.130-170
- [14] Odusote, K. et al, "West Africa's Regional Approach to Strengthening Health Workforce Information." CapacityPlus IntraHealth International (2012)
- [15] Ogunyemi O, CEDRIC: A Computerized Chronic Disease Management System for Urban, Safety Net Clinics, *MEDINFO 2010: Proceedings of the 13th World Congress on Medical Informatics Volume*; (2010) 160 208-212
- [16] Olatokun C, Adeboyejo C, Information and Technology Use by Reproductive Health Workers in Nigeria; State of the Art, Issues and Challenges. *Human technology*; (2009) 5.2, 181–207
- [17] Talbot, David. "The mPedigree Network, based in Ghana, lets people determine with a text message whether their medicine is legitimate." *MIT Technology Review* (2013): 48-49.
- [18] Pakenham-Walsh, N, and Bukachi, F, Information needs of health care workers in developing countries: a literature review with a focus on Africa. *Human Resources for Health*; (2009) 7.30
- [19] Rotich, J. K., et al. "Installing and implementing a computer-based patient record system in sub-Saharan Africa: the Mosoriot Medical Record System." *Journal of the American Medical Informatics Association* 10.4 (2003): 295-303.

- [20] Zennaro F, et al. "Digital radiology to improve the quality of care in countries with limited resources: a feasibility study from Angola." *PloS one*; 8.9 (2013): e73939.
- [21] Zurovac D, Talisuna AO, Snow RW, "Mobile phone text messaging: tool for malaria control in Africa." *PLoS medicine* 9.2 (2012): e1001176.



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eHealth strategy development: a case study in Tanzania

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Many developing countries have used different frameworks, some ad hoc and some more formal, to develop their national eHealth strategies. There is increasing interest in eHealth strategy in developing countries, as well as a move to a more integrated and less fragmented set of eHealth solutions that contribute to health objectives and outcomes. Developing a national eHealth Strategy from the national health sector priorities should lead to implementation of sustainable eHealth solutions. Some existing frameworks for developing national eHealth strategies can be difficult to implement effectively. This paper presents how an alternative country eHealth Strategy framework was applied in Tanzania to develop the Tanzania eHealth Strategy 2013–2018. This alternative framework begins with reviewing Tanzania's Health Sector Strategic Plan III (2009–2015) priorities and goals, from which the eHealth strategy's priorities and goals are developed. The process is informed by the current state of eHealth and the proposed future state of eHealth. It defines the vision, mission, and guiding principles, well-defined strategic objectives and actions, a high-level roadmap, and an appropriate monitoring and evaluation (M&E) framework. The application of this alternative eHealth strategy development framework is based on theories of business process re-engineering, strategy development, and complex systems analysis.

Background and Purpose: There is increased interest by national and local governments, partners, and private institutions to invest in global and national eHealth initiatives [1]. These investors recognize that eHealth can transform health care delivery by enabling information access and supporting health care operations, management, and decision making. However, without a clear national plan and coordination, this transformation will not materialize. The successful application of eHealth requires eHealth strategies that are aligned with stakeholders' respective health priorities.

Materials and Methods: This case study presents the practical application of this alternative eHealth Strategy framework in Tanzania to develop the Tanzania National eHealth Strategy 2013–2018. The alternative eHealth Strategy framework was presented at the American Medical Informatics Association 2014 Annual Symposium [2]. The Tanzania eHealth Strategy development process applied this framework, with iterations that integrated stakeholders' feedback into revised Tanzania National eHealth Strategy versions during a period of 1 year.

Results: The eHealth strategy development framework was applied in Tanzania, starting with a 1-week key stakeholders' workshop (health sector and information and communication technology /eHealth experts) in September 2012. Continued Ministry of Health and Social Welfare (MoHSW) and stakeholder review and input resulted in final Tanzania National eHealth Strategy 2013–2018 publication and adoption in September 2013 and launch of the National eHealth Steering Committee (NeHSC) by the Government of Tanzania. The eHealth Strategy was used to develop a detailed costed eHealth action plan to understand the resources needed for implementation, and allow funders to determine which areas they could support.

Discussion and Conclusion: Tanzania developed an eHealth Strategy that is currently being implemented in a phased approach. Completely implementing this strategy under the guidance of the NeHSC should assist Tanzania to achieve its health sector goals. This strategy development process can be used by institutions or national and subnational governments who need to develop a multi-year eHealth Strategy or revise their existing eHealth strategy.

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1 Introduction

The Tanzania mainland's healthcare system, through its ongoing health sector reforms, aims to improve health outcomes. As part of these reforms, the Ministry of Health and Social Welfare (MoHSW) developed its strategic plan, *Health Sector Strategic Plan III* (HSSP III) [3], to guide priority setting and deployment of resources in the health sector. The MoHSW recognizes the potential of information and communication technology (ICT) to transform healthcare delivery by enabling information access and supporting healthcare operations, management, and decision making. However, the Tanzanian health sector is characterized by a fragmented landscape of ICT pilot projects and numerous data and health information system (HIS) silos, with barriers to the effective sharing of information among healthcare participants [4, 5]. Although the government, partners, and private institutions continue to invest in various ICT initiatives, without a national plan and coordination, duplication of HIS, ineffective expenditure, and the creation of new solutions that cannot be integrated or scaled across the continuum of care [3, 6] will continue.

Often, there is a missing causal link between health sector priorities and how technology can be applied to these priorities [4, 7]. For example, because eHealth strategies are often developed by technologists, these strategies are very ICT focused and difficult for health systems actors to understand and use [6, 8], or these strategies do not comprehensively address the roles and responsibilities of many different stakeholders [6, 9]. The World Health Organization (WHO)/ International Telecommunication Union (ITU) National eHealth Strategy Toolkit can be used by countries to develop their national eHealth Strategy. The Pan American Health Organization recommends that national eHealth strategies should be developed from health sector priorities and that ICT can be used to expand access to health services and improve the quality of those services, but gave countries the ability to choose their own eHealth Strategy framework to use [10]. Australia and Rwanda published their eHealth strategies referencing their own country priorities without specifically detailing the strategy development framework followed [11, 12, 13].

Another eHealth Strategy Development Framework [8] proposes a model that adapts a Telehealth Strategy Development Framework and embeds more business strategy and cognitive process theory and approaches. WHO and the ITU developed the WHO eHealth Strategy Toolkit [14] to enable countries to adapt and use the latest ICT in health for the measurable benefit of their citizens. The Business Motivation Model [15] provides a scheme or structure for developing, communicating, and managing business plans in an organized manner, focusing on the Ends and Means of business plans and influencers that shape business plans and strategies. The Ishikawa Fishbone Diagram [16] uses a causal diagram to show the causes of specific events, and is often used in strategy development to develop business strategies to achieve overall business goals. Elements from these frameworks were combined in the alternative eHealth Strategy framework that was presented at the American Medical Informatics Association 2014 Annual Symposium [2].

The Tanzania eHealth Strategy was developed over several years. During 2008–2009, a MoHSW-appointed Steering Committee oversaw the participatory process consisting of five formal meetings along with numerous informal sessions and technical consultations. The committee incorporated inputs and produced a draft eHealth Strategy. However, the MoHSW did not adopt this strategy, which led to the MoHSW taking a revised approach to the eHealth strategy development in August 2012. This paper focuses on the eHealth Strategy development, which started in August 2012, using the alternative eHealth Strategy development framework [2].

2 Materials and methods

The MoHSW recognized the potential of ICT to transform healthcare delivery by enabling information access and supporting healthcare operations, management, and decision making. The MoHSW recognized the need for a nationally coordinated eHealth strategy and plan to meet their strategic goals, as outlined in the HSSP III [3]. The MoHSW established a core eHealth strategy development team (core team) during August 2012, which included MoHSW ICT, Telehealth, health staff, and other eHealth and monitoring and

evaluation (M&E) advisors to proceed with defining the eHealth Strategy. This core team included the six authors of this paper, and we engaged key stakeholders at different points in the process to ensure that the strategy aligned with communities' priorities and needs.

While in country and in preparation for the eHealth Strategy development workshop, the core team reviewed the WHO eHealth Strategy Toolkit. During this review, the core team considered our experience developing technology strategies in the private sector, business process re-engineering, and the HSSP III eHealth's goals and drivers. As a result, the team combined elements from the three models described in the Introduction to draft an alternative eHealth Strategy development framework that could be applied in a 1-week workshop and follow up discussions in Tanzania [2]. In addition, during the practical application and refining of this framework in Tanzania over 12 months, the core team reviewed other national eHealth strategies (e.g., Canada, Kenya, Australia, Ghana, and Rwanda) [11, 17].

Because Tanzania conducts health sector strategic planning every 5 years, this eHealth strategy was developed with a 5-year timeline. It should be noted that it is challenging for many developing countries to implement a comprehensive eHealth strategy in 5 years. In fact, some international best practices propose that 10 years is a more realistic timeframe for eHealth subsystems [8, 18]. Building in adequate M&E into the strategy will support continued evaluation of progress and identify gaps and areas that may need to extend beyond the initial 5-year timeframe.

The development of the eHealth Strategy in Tanzania was an iterative process. Key stakeholders—MoHSW management, donor and implementing partners, MoHSW technical advisors, and regional and district health management teams—were involved during the process. Figure 1 describes the eHealth Strategy development process and the key activities involved in each section.

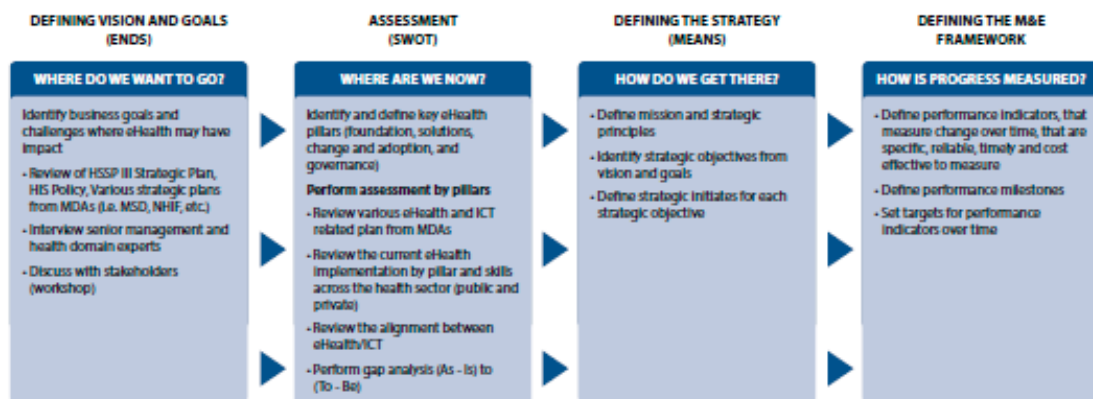


Figure 1. eHealth Strategy Development Process

The initial section of “Defining Vision and Goals (Ends)” includes conducting a desk review; convening a key stakeholders’ workshop; and during the workshop, establishing the business goals, challenges, and the Vision. The *Vision* describes what the health sector aspires to achieve by applying ICT in the health sector, and the *Goals* describe health outcomes in qualitative terms that reflect a realistic focus of the health sector and its direction for achieving the eHealth mission and vision. The next section focuses on conducting a Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis and completing a gap analysis. The third section (“Defining the Strategy [Means]”) focuses on defining the eHealth mission and strategic principles and refining the eHealth strategic objectives and related initiatives. The final section (“Defining the M&E Framework”) focuses on measuring the progress of the eHealth strategy’s implementation.

3 Results: Developing the eHealth Strategy in Tanzania

The core team led the process of developing and applying the framework in Tanzania and engaged stakeholders at different steps [2]. Then, based on the inputs gathered, the team developed the national eHealth Strategy. Stakeholder consultations included broad representation [6, 9] to ensure that the strategy took into consideration all health sector technical areas, and used both a top-down and bottom-up participant engagement approach.

3.1 Summary of Stakeholder Engagement

Table 1 provides a summary of meetings and workshops held by the eHealth Strategy core team, the key stakeholders, and results.

Workshop/Meetings	Core Participants	Results
Workshop: Oct 2012	ICT Unit MoHSW Chief Medical Officer, MoHSW Donor MoHSW Technical Advisors University of Dar Es Salaam University Computing Centre MoHSW Directorates Health District representation eHealth experts	Draft Mission, Vision, Goals, Strategic Principles, Strategic Objectives, Draft Actions, Initial M&E framework
Follow-up Meetings: Oct 2012–Dec 2012	eHealth Strategy core team	M&E Framework
Follow-up Meetings: Nov 2012–Mar 2013	MoHSW departments	Feedback and updates; Added “Change and Adoption” Pillar
Follow-up Meetings: Mar 2013–Jul 2013	Chief Medical Officer, Permanent Secretary	Feedback and updates
Launch Meeting: Sept 30, 2013	WHO, MoHSW broad representation, Minister of Health, e/mHealth projects, donors, and press	Launched eHealth Strategy Launched NeHSC

Table 1. eHealth Strategy Workshops and Meetings

3.2 Initial Stakeholder Workshop in October 2012

3.2.1 Defining Vision and Goals

The stakeholders started by reviewing the HSSP III and the business goals included in the plan to ensure that participants understood the key goals of HSSP III. The stakeholders were divided into small groups, with four people per group, and each group was given a set of business goals along with the following instructions: (1) determine the possible strategic theme(s) under each goal/challenge; (2) clearly articulate the business goal/challenge; and (3) Identify how eHealth can support the selected goal/challenge. Each group presented its results and described how its results can support the selected goals and challenges identified in HSSP III. The stakeholders were led through a process to review how to define the Mission and Vision for any strategy, and then specifically reviewed eHealth strategies from the reference countries of Kenya, Australia, Ghana, Rwanda [11], and Canada [5] focusing on each country’s description of its Vision and Mission. The core team selected Australia and Canada because it presented a mature eHealth strategy; and we selected Kenya, Ghana, and Rwanda because these countries, from 2010 onwards, sought to harmonize eHealth activities. For the final small-group activity, stakeholders reviewed the MoHSW’s Vision and Mission [19], developed their own versions of the Tanzania eHealth Vision and Mission, and then each group presented its results. The larger group reviewed and combined/updated to create the draft Tanzania eHealth Vision and Mission.

3.2.2 Assessment (SWOT)

The “Assessment SWOT” step focused on completing a SWOT analysis of eHealth in Tanzania, and identifying key eHealth pillars—Foundation, Solutions, Change and Adoption, and Governance—that are necessary to implement the eHealth Strategy. A gap analysis was also completed comparing the “as-is” state to the “to-be” state to ensure that the gaps were understood.

3.2.3 Defining the Strategy (Means)

The “Defining the Strategy (Means)” step focused on determining how to achieve the Vision and Goals based on the SWOT analysis, and identified what actions were needed. The actions are influenced by the

Mission (e.g., what does eHealth mean in the health sector?). From these actions and the results of gap analysis, strategic objectives were developed in the four key eHealth pillars with associated strategic actions.

Next, stakeholders reviewed the aforementioned reference country strategies focusing on their guiding principles and objectives, and then discussed what these meant in terms of implementing HIS. The stakeholders completed a group exercise, where the business goals/challenges and how eHealth can support these goals/challenges were mapped to draft eHealth Strategic Objectives (SOs). The stakeholders were divided into small groups, and assigned a set of SOs and tasked with improving the description; afterward, each group discussed strategic actions needed to implement these SOs. Each small group also started to draft its own list of guiding Strategic Principles (SP) and the strategic actions. The groups reconvened to review the SOs and the SPs and refine these further. All of these involved facilitated discussion. An example of two SPs that were selected include (1) Guarantee patient information right, integrity, and confidentiality in line with the public health access need; and (2) Cost effective, efficient, and benefit driven solutions in limited resources environment that lead to future growth potential.

3.2.4 Defining the M&E Framework, including eHealth Governance and Roadmap

Before the workshop, different discussions had been held, and research conducted on how other countries govern eHealth work [7, 11]. During the workshop, the core team facilitated discussions by sharing Rwanda's and Australia's different governance models [11, 13]. Rwanda's model recommends for its Ministry of Health to create an eHealth department to govern eHealth, whereas Australia's model recommends a National eHealth governing board that is responsible for setting overall national eHealth priorities, funding, and monitoring implementation, supported by a National eHealth Entity that coordinates and oversees execution of eHealth work reporting to the governing board. The team discussed a Tanzania National eHealth Steering Committee (NeHSC) as a possible option, which would be in line with other technically focused groups that have been convened in specific Tanzania technical areas, such as the M&E Technical Working Group. The stakeholders discussed how this might work, membership, roles and responsibilities, and frequency of meeting. The final discussion focused on regulatory issues, and the stakeholders reviewed the SPs to see if this required adding another SP. The stakeholders listed the steps needed to review existing laws, and if a law was needed to setup the NeHSC and to protect patient privacy (harmonized with managing information for public health needs). The stakeholders then developed a high level roadmap for implementation, and the M&E framework for eHealth Strategy implementation measurement. At the end of the workshop, this M&E framework was in the very early stages of development.

3.3 Ongoing Stakeholder Engagement

A series of individual meetings were held with MoHSW Department Directors to obtain additional senior-level input and review the draft eHealth Strategy [5], which assisted in building broader ownership. During each meeting, revisions and recommendations were documented and then reviewed by the eHealth Strategy core team, along with more complete M&E framework development. A key approach included working within MoHSW senior management, the Permanent Secretary (PS), the Chief Medical Officer (CMO), and other senior MoHSW Department Directors who are key to setting direction in the health sector and their engagement and approval is required to adopt any new strategy. Some members of the eHealth core team presented the draft eHealth Strategy to the MoHSW management team to ensure their feedback was integrated so the eHealth Strategy had broad MoHSW acceptance and ownership. Discussions took place iteratively about the makeup of the NeHSC. Additional discussions were held on the terms of reference for members and the role of the chairperson and secretariat.

3.4 eHealth Strategy Launch September 30–October 1, 2013

A large group of stakeholders (≥ 80) met during a 2-day workshop, where the MoHSW launched the eHealth Strategy (with support from the WHO), presenting on the current eHealth investments, and areas that need continued investment. Six implementing partners working in the eHealth/mHealth sector gave presentations about their projects. Discussions were held about the NeHSC and its role in achieving the vision of the eHealth Strategy. The Government of Tanzania formally adopted the eHealth Strategy, the NeHSC was formally inaugurated, and the first meeting of the NeHSC was convened for October 2, 2013. Tanzania has

invested in developing a comprehensive eHealth Strategy with the understanding that the strategy forms the foundation that will eventually aim to produce a safer, high-quality, equitable, efficient, and sustainable health system that is equipped to respond to emerging health sector cost and demand pressures.

4 Discussion and Conclusion

The eHealth Strategy was guided by Tanzania's HSSP III (2009–2015), which identifies health sector priorities. The initial background work occurred over a period of 2 years, culminating in a 1-week multi-stakeholder workshop (health sector and ICT/eHealth experts) in September 2012 that used the alternative eHealth Strategy Development framework to develop the first official version of the draft eHealth Strategy [2]. Through continued meetings with key stakeholders and revisions to the draft eHealth Strategy, the final Tanzania eHealth Strategy 2013–2018 was published on September 30, 2013.

The experience in Tanzania of developing the national eHealth Strategy informed by the country health strategic plan priorities, determining where ICT can support achieving health sector goals, and ensuring a participatory approach with key stakeholder involvement at all stages of development led to national adoption and Tanzanian ownership of the national eHealth Strategy. It is essential that members of the eHealth Strategy core development team have expertise in the following skills:

- leading and facilitating participatory workshops
- collaborating with the ministry and host country partners to identify key stakeholders
- understanding how ICT can transform the delivery of health services
- translating technology terms in plain language to successfully engage in discussions with senior health leaders.

The stakeholders engaged in the eHealth Strategy development process found the approach pragmatic, and could see immediate results from their work through iterations of the draft eHealth Strategy that was easy to understand and linked back to the national health priorities while grounded in the current situational analysis. The eHealth Strategy is also concise and user-friendly. We believe that the eHealth Strategy will lead to more sustainable development of eHealth solutions in Tanzania. Of course, the strategy is just one step in a long process to build a safer, high-quality, equitable, efficient and sustainable health system, and the goal of the NeHSC and their support is to ensure that the strategy is implemented, with ongoing M&E to measure lessons learned and also to adapt to ongoing changes in enabling technologies and M&E results.

Limitations in the application of the framework in Tanzania include the delay from the initial workshop in September 2012 to the official launch in September 2013. This was a result of resource constraints for the workshop held in September 2012, as there were limits to the number of stakeholders that could be included. Therefore, core team members had to follow up with individual MoHSW departments and leadership, which resulted in many rounds of revisions as feedback was integrated along the way; in addition, because of staff turnover within the ministry, we had to conduct orientation and engagement. Overall, the harmonization process of eHealth Strategy harmonization lasted one year, which delayed the launch and adoption of the eHealth Strategy. In addition, because this framework has only been applied in Tanzania, and the eHealth Strategy is currently being implemented, it is too early to compare the effectiveness of this strategy with other country eHealth strategies.

Institutions and national and subnational governments can apply this case study approach, specifically countries of similar size and complexity, with many disparate existing eHealth initiatives that are not coordinated and led from a technology perspective.

This eHealth Strategy has been shared with donors, the MoHSW Technical Working Group, the Prime Minister's Office for Regional and Local Government, Tanzania eGovernment Initiative, and regional and district health staff. This eHealth Strategy is currently being used by the MoHSW to review and coordinate across new and existing eHealth initiatives.

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References

- [1] Lewis, T., C. Synowiec, G. Lagomarsino, and J. Schweitzer. "E-Health in low and middle income countries: findings from the Center for Health Market Innovations." *Bulletin of the World Health Organization (WHO)* 2012;90:332-340. doi: 10.2471/BLT.11.099820, 21 February 2012, <http://www.who.int/bulletin/volumes/90/5/11-099820/en/> (accessed February 20, 2015).
- [2] Elias, M, J. Mukela., H. Rulagirwa, A. Swai, H. Danford, S. Perera, and N. Darcy (2014, November). "eHealth Strategy Transforming Health Care Delivery in Tanzania." Poster presented at 2014 American Medical Informatics Association Annual Symposium, Washington, DC.
- [3] The United Republic of Tanzania Ministry of Health and Social Welfare (MoHSW). 2009. Health Sector Strategic Plan III (July 2009–June 2015). <http://ihi.eprints.org/970/1/HealthSectorStrategicPlan.pdf> (accessed November 13, 2014).
- [4] World Health Organization (WHO) Health Metrics Network. 2007. Assessment of the Country Health Information System in Tanzania http://www.who.int/healthmetrics/library/countries/HMN_TZA_Assess_Draft_2007_05_en.pdf (accessed November 13, 2014).
- [5] Tanzania MoHSW. 2010. Monitoring and Evaluation Strengthening Initiative, Combined Plan, 5 Year Operational Plan and Year 1 Work Plan.
- [6] van Gemert-Pijnen, J. EWC, N. Nijland, M. van Limburg, H.C. Ossebaard, S.M. Kelders, G. Eysenbach, and E. Seydel. 2011. A Holistic Framework to Improve the Uptake and Impact of eHealth Technologies. *Journal of Medical Internet Research* 13, no.4 (December 13). <http://www.jmir.org/2011/4/e1111/> e1111. (accessed November 13, 2014).
- [7] Foster, R. 2013. Assessing the development process of the eHealth strategy for South Africa against the recommendations of the WHO/ITU National eHealth Strategy Toolkit. *Journal of the International Society for Telemedicine and eHealth* 1, no 2. <http://journals.ukzn.ac.za/index.php/JISfTeH/article/view/36>.
- [8] Scott, R.E., and M. Mars. 2013. Principles and Frameworks for eHealth Strategy Development. *Journal of Medical Internet Research* 15 no. 7. <http://www.jmir.org/2013/7/e155/> (accessed November 13, 2014).
- [9] Van Velsen, L., J. Wentzel, and J. EWC Van Gemert-Pijnen. 2013. Designing eHealth that Matters via a Multidisciplinary Requirements Development Approach. *JMIR Res Protocol* 2 no 1. (Jun 24) e21.
- [10] Pan American Health Organization. 51st Directing Council: 63rd Session of the Regional Committee Final Report, Washington, D.C., September 2011. pp 26-30. http://www.paho.org/hq/index.php?option=com_docman&task=doc_download&gid=16913&Itemid= (accessed November 13, 2014).
- [11] International Society for Telemedicine and eHealth. National eHealth Strategies. http://www.isfteh.org/media/category/national_ehealth_strategies (accessed November 13, 2014)
- [12] Government of Western Australia eHealth Strategy Frequently Asked Questions. <http://www.health.wa.gov.au/ehealthwa/home/faq-strategy.cfm> (accessed November 13, 2014).
- [13] Australian Government Department of Health. Australia National eHealth Strategy. 2008. <http://www.health.gov.au/internet/main/publishing.nsf/Content/National+Ehealth+Strategy> (accessed November 13, 2014).
- [14] WHO and International Telecommunication Union. 2012. National eHealth Strategy Toolkit. Available from: http://www.itu.int/pub/D-STR-E_HEALTH.05-2012-PDF-E.pdf (accessed November 13, 2014).
- [15] The Business Rules Group. 2007. The Business Motivation Model. Release 1.3. http://www.businessrulesgroup.org/second_paper/BRG-BMM.pdf (accessed November 13, 2014).
- [16] Mind Tools. "Cause and Effect Analysis: Identifying the Likely Causes of Problems (Ishikawa Fishbone Diagram Strategy)." http://www.mindtools.com/pages/article/newTMC_03.htm (accessed November 13, 2014).
- [17] British Columbia eHealth Steering Committee. 2005. eHealth Strategic Framework. http://www.health.gov.bc.ca/library/publications/year/2005/ehealth_framework.pdf (accessed November 13, 2014).

- [18] Broomhead, S., and T. Jones. 2011. eHealth Strategies for Africa: A White Paper. <http://tintree.org/whitepapers/eHealth%20Strategies.pdf> (accessed November 13, 2014).
- [19] Tanzania MoHSW. "Mission and Vision." <http://www.moh.go.tz/index.php/about-us/mission-and-vision> (accessed November 8, 2014).

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

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Background and Purpose: Community Health Workers (CHW's) are often the only link to healthcare for millions of people in the developing world. Mobile-health or 'mHealth' tools can support CHWs in monitoring and evaluation, disease surveillance, and point-of-care diagnostics. However, there is a lack of evidence on the impacts of mHealth on CHW performance. To address this gap, we determine a set of measures along which to evaluate the impact of mHealth tools on CHW performance.

Methods: Using a quasi-experimental post-test design we compare CHWs using an mHealth tool (n=196) with those using a paper-based system (n=199). The empirical context for the study is peri-urban communities in Kenya and data was collected using a survey instrument.

Results: Results provide evidence of impacts of mHealth tool use on objective and perceptual performance measures.

Conclusions: CHWs using mHealth tools capture and transmit higher percentages of monthly cases on time and without missing data, and are highly satisfied with the contribution of the tool to their performance.

Keywords: mHealth, Community Health Workers (CHWs), Performance

1 Introduction

Community Health Workers or CHW's are often the only link to healthcare for millions of people in the developing world. They contribute by conducting monitoring and evaluation exercises and disease surveillance, and providing point-of-care diagnostic support [2, 24]. CHW's also link households in their communities to skilled healthcare practitioners in clinics and hospitals – for the treatment of complicated illnesses or specialized maternal care [2]. As a consequence, supporting CHW's at the point-of-care is thus of significant importance. One-way to achieve this is through the application of mobile-health or 'mHealth' technologies [2, 3]. These platforms offer the promise of improving CHW performance by facilitating the capture, storage, transmission and retrieval of health data – whilst representing the most immediate and cost effective way to save lives and improve care in low-resourced community settings [4]. Unfortunately, mHealth initiatives are often unsustainable pilot projects that not only fail to 'scale-up' meaningfully, but also expire once initial funding is exhausted. For example, between 2008 and 2009, 23 mHealth initiatives were introduced in Uganda, yet none 'scaled-up' beyond the pilot phase. Similarly, in 2009, despite the launch of over 30 mHealth initiatives in India, none were fully deployed to scale [4]. This is exacerbated by a lack of substantive evidence regarding the impacts of mHealth tools on healthcare service delivery and CHW performance [2, 4]. The purpose of this paper is to address this gap. More specifically, this paper aims to (a) determine a relevant set of measures along which to evaluate the impact of mHealth tools on CHW performance, and (b) use these measures to compare CHW's in mHealth technology-enabled and paper-based system settings. The study employs a quasi-experimental

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post-test-only design [5, 6, 7, 8] to compare a group of CHW's using an mHealth tool (see Figure 1), to a reference group using a traditional paper-based tool – where the empirical context for the study is peri-urban communities in Kenya. This comparison would provide much needed evidence of mHealth impacts on CHW performance. In order to be an effective link between their communities and the broader healthcare system (including hospitals and clinics) - CHW's have to do a reliable job of capturing health data and reporting on typical tasks of monitoring, health promotion, and referral that they perform. It is therefore important to evaluate the extent to which mHealth can be associated with improved task performance and enhanced reporting.

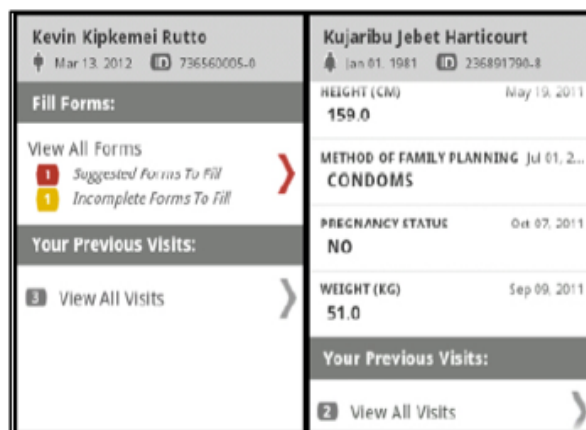


Figure 1. Monitoring task interface for 'OpenMRS' compatible mHealth tool used in Nandi County (one of the study sites)

There has been sustained interest in understanding the impacts of Information Technologies (IT's) on individual user performance [9]. Various studies use self-reported, often perceptual indicators of individual performance in the accomplishment of tasks – whereby higher performance implies a mix of improved efficiency, effectiveness, and higher quality [9, 10, 11, 12, 13, 14]. These dimensions of individual performance can be understood as follows. Firstly, *effectiveness* is the individual's completion or accomplishment of tasks and includes the speed with which the tasks are performed [9, 12]. The availability of advanced information technologies is often associated with improvements in effectiveness by aiding the timeliness of output produced [15] - in addition to providing information in a format that easily allows for reliable decision support. Secondly, *efficiency* is the time taken to complete tasks using minimal resources or the extent to which an individual does more work in the least amount of time and at lower cost [9]. Advanced information technologies are expected to improve user efficiency by enabling or limiting work activities [15], by automating time-consuming tasks or reducing wastage of available resources. Thirdly, *quality* is the extent to which an individual performs a task or set of tasks, whilst committing minimal errors, with improved decision making yielding better output [9, 11, 12]. The availability of advanced information technologies is expected to enhance the quality of information [15] by allowing for improved data validation and thus reducing or preventing errors. To capture such performance, many past studies e.g. [16, 17, 18] have used self-reported perceptual measures, with items such as 'the system has improved my productivity'. In addition to these perceptual aspects of performance, a number of more objective indicators also exist in the CHW context [19]. These encompass measures similar to workload (number of reported monthly cases), throughput (% of households visited monthly), flow time (hours taken to complete case reports weekly), and error rate (% of reports returned to sender due to errors or inconsistencies). Thus both perceptual and objective measures can usefully be included in a study of mHealth tool impacts on CHW performance. The study design used to compare the individual performance of mHealth tools users to paper-based tool users is presented next.

2 Materials and methods

To address the study's objective of comparing performance of CHWs operating in mHealth versus paper-based settings, a quasi-experimental post-test-only design was used [5, 6, 8]. More specifically, an intervention (X), namely the use of an mHealth tool, has been implemented for one group of CHW's but

not for a second control group [5]. If performance (O) were compared across both groups, then (O1) would be individuals' performance in the mHealth tool user group after the intervention, and (O2) would be individuals' performance in the paper-based tool user group. This relationship is expressed in the following formula:

$$\begin{array}{l} \text{Interventiongroup (mHealth Tool Users): } X\ O1 \\ \text{Controlgroup (Paper-Based Tool Users): } O2 \end{array}$$

This design allows us to evaluate the differences in performance between the intervention group comprising users of mHealth tools, and the control group made up of users of paper-based tools. The use of this quasi-experimental design was necessary because in this scenario, the researchers had no control over the introduction of the intervention, and random assignment of CHWs to either the intervention or control groups was not possible. Moreover, since the intervention was already in progress at the time of the study, it was also not possible to carry out a pre-test to ensure equivalence at baseline [7]. Consequently, the study relied on a post-test-only design [5]. A cross-sectional survey design was used to collect data from CHWs in each of the two groups. A structured questionnaire was developed as the research instrument of choice [20, 21]. For the intervention group (X O1), data was obtained from CHWs using an mHealth tool operating within peri-urban communities in the counties of Siaya, Nandi, and Kilifi in Kenya. For the control group (O2), data was obtained from CHWs using a paper-based reporting system operating within peri-urban communities in the counties of Nairobi and Nakuru in Kenya. A proportionate stratified sampling approach with systematic random sampling [22] was used to construct the sampling frame. Specifically, within each county, 'k' number of Community Health Units (CHU's) comprising CHW's was identified, and a proportional number of CHW's systematically drawn from lists of CHW's operating in each unit. The number drawn represented the sampling frame for each county. **Figure 2** illustrates the sampling approach followed.

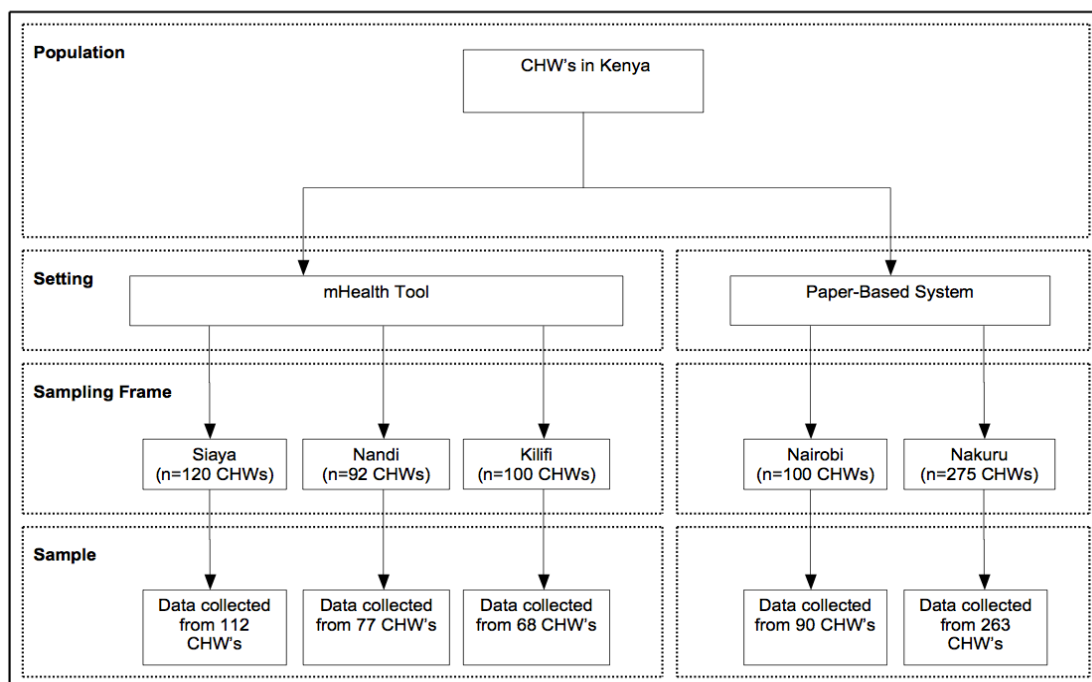


Figure 2. Sample design

In order to ensure content validity i.e. the extent to which items fully reflected the concepts being measured [23], the survey instrument was firstly, developed from literature and secondly, administered to eight experts - four academics (two Information Systems (IS) scholars and two social scientists), and four healthcare service practitioners (one community health service expert and three health service field officers) – all asked to scrutinize it and give an informed opinion about the item measures [7]. To ensure face validity [7], the survey instrument was administered in a pilot study involving thirteen CHW's from

the mHealth tool user group and 15 CHW's from the paper-based tool user group. Their recommendations were incorporated into the instrument. For individual performance, the variables along which we describe and compare these two user groups are both perceptual and objective measures that are relevant to the context of CHW work. Eight items were used to capture the perceived impacts of the respective tool (mHealth or paper-based) on the effectiveness, quality, and efficiency of the CHW. Items 1, 4, 5, and 7 were drawn from [18] measuring effectiveness, quality, and efficiency, as aspects of task productivity as a perceived impact of Information Technology (IT) use. Items 2, 3, and 8 were drawn from [17], who also used these to measure effectiveness and quality, whereas item 6, drawn from [16], provided an additional measure of task effectiveness.

To ensure construct validity, these individual performance measures were drawn from prior validated instruments [21]. There were eleven objective performance measures – including reporting on various quantities of work, as well as percentages affecting task completion and error rates. These measures covered CHW workload (number of reported monthly cases), throughput (% of households visited monthly), and flow time (hours taken to complete case reports weekly) to provide measures of effectiveness in tool reporting. CHW error rate (% of reports returned to sender due to errors or inconsistencies) and completeness of reporting (% of complete monthly reports) provided measures of quality of reporting.

These measures were deemed most relevant following discussions held in the field with community health specialists, coordinators, extension workers (2 to 4 in each county), and a handful of experienced CHW's. Various documents also supported selection of these performance indicators, including policy reports on health worker performance assessment frameworks, monthly performance evaluation checklists, and Community Health Extension Worker (CHEW) summary indicators. District level support supervision checklists from the Ministry of Health (MOH) - Division of Community Health Services (DCHS), community strategy manuals, and MOH registers used by CHW's for reporting were also reviewed. Some of these indicators are conceptually similar and comparable to those employed in health studies by [19], [20], [25], and [26], yet adapted and contextualized for this study. The survey instrument also elicited demographic data, namely – age, gender, education level, experience as a CHW (in years), and tool (mHealth or paper-based) use experience (in months). **Table 1** shows the survey instrument items used to measure perceptual and objective CHW performance.

3 Results

3.1 Response Rate and Sample Profile

The survey instrument was administered to 687 respondents – 312 in the intervention group comprising mHealth tool users (O1), and 375 in the control group (O2) comprising paper-based tool users. For O1, 257 responses were received from mHealth tool users, yielding an 82% response rate. For O2, 353 responses were received from paper-based tools users, for a 94% response rate. The data obtained from respondents was screened for missing values and outliers using multivariate methods [27]. Cases with large amounts of missing data or those with consistently extreme response sets were deleted. This resulted in the exclusion of 52 responses from the mHealth tool user group and 136 from the paper-based tool user group. Consequently, 205 usable responses for the mHealth tool user group, and 217 usable responses for the paper-based tool user group were retained for analysis. The large number of missing responses was not unexpected given conditions in the field setting in which the instrument was administered. Table 2 shows that across the two user groups, most respondents were relatively young. Amongst mHealth tool users, the majority reported ages between 25 and 34 years (50%). Although a fairly similar trend was followed amongst paper-based tool users (36%), there was however a statistically significant difference in age between the two groups ($U = 18418.500, p < 0.001$). Specifically, there were proportionately more respondents aged 45 years and older in the paper-based tool user group. Male and female users across the two groups did not differ significantly: $\chi^2 = 0.294, p = .588$. In both groups, there are more female (62% use mHealth tools and 65% use paper-based tools) than male (38% use mHealth tools and 35% use paper-based tools) users. A Kruskal-Wallis test [28] showed users' education levels did not differ significantly across the two groups: $\chi^2 = 0.239, p = .625$. Most mHealth tool users have attained secondary level education (74%). This is also evident for paper-based tool users, with most respondents (77%) educated up to secondary school level. Similarly, there was no statistically significant difference in tool use

experience across the groups: $\chi^2 = 0.002, p = .965$. Amongst mHealth tool users, most reported tool use for five or more months (79%). Most paper-based tool users reported similar levels of tool use experience (78%). Although, paper-based tool users had more years of experience as CHW's (median = 3.50) than mHealth tool users (median = 3.00 years), this difference was not statistically significant ($p = .484$). Significant differences were thus found only in relation to age, whilst none were found with respect to gender, experience as a CHW, education level, and tool use experience – thus establishing areas of non-equivalence at baseline [29], controlled for in subsequent analyses. Given the low number of respondents having 'Less Than 1 Month' and '1-2 Months' of tool use experience, it was decided to omit them from further analyses, and only those with '3-4 Months' and '5 or More Months' were retained. The relationship between the objective user performance indicators and these relatively more experienced tool users within each setting, i.e. mHealth (n=196) and paper-based (n=199) tool use is discussed in the next section.

Table 1. CHW Performance Indicators

No	Item	Measure	Dimension		
			Effectiveness	Efficiency	Quality
User Perceptions					
PUP1	The mHealth / paper-based tool makes me more productive.	Perceptual	✓		
PUP2	The mHealth / paper-based tool makes me more effective with patients.	Perceptual	✓		
PUP3	The mHealth / paper-based tool improves my quality of patient care.	Perceptual			✓
PUP4	The mHealth / paper-based tool helps me save time.	Perceptual		✓	
PUP5	The mHealth / paper-based tool helps me finish my tasks more quickly.	Perceptual	✓		
PUP6	Using the mHealth / paper-based tool improves my effectiveness in performing tasks.	Perceptual	✓		
PUP7	The mHealth / paper-based tool improves the quality of my task performance.	Perceptual			✓
PUP8	The mHealth / paper-based tool helps me make fewer errors in reporting.	Perceptual			✓
Health Data Capture and Transmission					
OUP1	How many households do you visit per month?	Objective	✓		
OUP2	What percentage of the households visited are you able to report?	Objective	✓		
OUP3	Of the households visited, how many monitoring cases do you report per month?	Objective	✓		
OUP4	Of the households visited, how many health promotion cases do you report per month?	Objective	✓		
OUP5	Of the households visited, how many referral cases do you report per month?	Objective	✓		
OUP6	In a typical week, how much time (in hours) do you take to complete reports for monitoring cases?	Objective		✓	
OUP7	In a typical week, how much time (in hours) do you take to complete reports for health promotion cases?	Objective		✓	
OUP8	In a typical week, how much time (in hours) do you take to complete reports for referral cases?	Objective		✓	
OUP9	Of the cases reported per month, approximately what percentage are completed on time?	Objective	✓		
OUP10	Of the reports completed for all cases per month, what percentage are complete (i.e. no missing data)?	Objective			✓
OUP11	What percentage of the reports completed are returned to you for additional information due to errors or inconsistencies?	Objective			✓

3.2 The Influence of Setting on Objective CHW Performance

Analysis of Covariance (ANCOVA) was effected to compare the two groups of tool users (mHealth versus paper-based) along the eleven objective performance indicators. We controlled for demographics including age, gender, experience as a CHW, education level, and tool use experience. Significant differences across the groups were found for only two of the eleven objective performance measures, i.e.

OUP9 (percentage of monthly cases reported on time), and OUP10 (percentage of complete monthly cases reported). No significant differences were found for the nine remaining objective user performance indicators. However, education level, tool use experience, and experience as a CHW, were found to have effects on six of the eleven objective performance measures, i.e. OUP1 (monthly household visitations), OUP2 (percentage of monthly household visitations), OUP4 (monthly health promotion cases reported), OUP9 (percentage of reported monthly cases reported on time), OUP10 (percentage of complete monthly cases reported), and OUP11 (percentage of reports completed with no errors or inconsistencies). **Table 2** shows the differences in tool use setting and objective performance.

Figure 3 shows percentages of reports completed on time for mHealth versus paper-based tool users (OUP9). While 12% of mHealth tool users were able to report 90-100% of cases on time, only 4% of paper-based tool users were able to do the same. Moreover, 37% of mHealth tool users reported more than 60% of cases on time, whilst only 27% of paper based tool users managed the same. This impact of mHealth use on OUP9 is significant ($F=16.546, p < 0.001$).

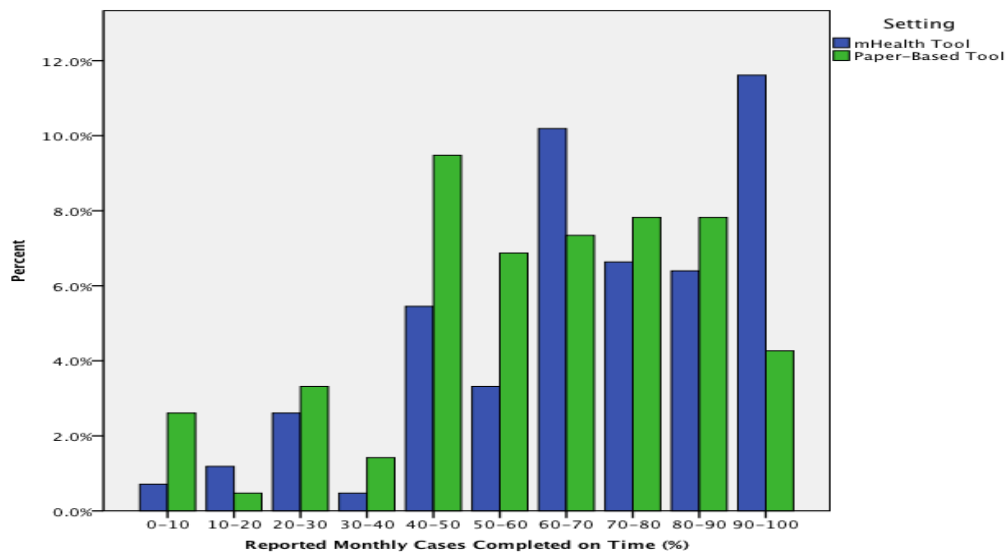


Figure 3. Differences in reported monthly cases completed on time

In addition to the effects of the tool itself, tool use experience was also found to have an effect on OUP9, where $F(1, 357) = 20.33, p = 0.000, \text{partial } \eta^2 = .994$. This effect is depicted in **Figure 4**, which illustrates a plot of the interaction between tool use experience and setting along performance indicator OUP9.

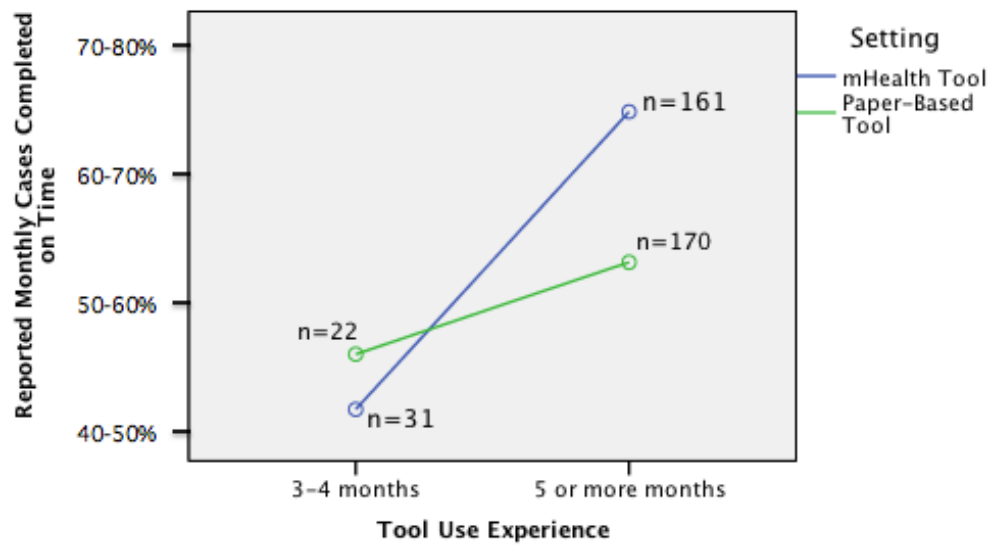


Figure 4. Effect of tool use experience on monthly household visitations reported

Table 2. Differences in setting and objective user performance

		F-ratio	Sig (p)	Partial η^2
Setting Significant				
OUP9.	Of the cases reported per month, approximately what percentage is completed on time?	16.546	0.000***	.982
Tool Use Experience was found to have an effect on OUP9, where $F(1, 357) = 20.33$, $p = 0.000$ ***, partial $\eta^2 = .994$.				
OUP10	Of the reports completed for all cases per month, what percentage is complete (i.e. no missing data)?	10.104	0.002*	.887
Tool Use Experience was found to have an effect on OUP10, where $F(1, 357) = 12.02$, $p = 0.001$ *, partial $\eta^2 = .933$.				
Setting Not Significant				
OUP1	How many households do you visit per month?	0.001	0.975	0.050
Education Level was found to have an effect on OUP1, where $F(1, 357) = 9.77$, $p = 0.002$ *, partial $\eta^2 = .876$				
OUP2	What percentage of the households visited are you able to report?	2.747	0.098	.380
Tool Use Experience was found to have an effect on OUP2, where $F(1, 357) = 11.94$, $p = 0.001$ *, partial $\eta^2 = .931$.				
OUP3	Of the households visited, how many monitoring cases do you report per month?	0.138	0.711	0.066
OUP4	Of the households visited, how many health promotion cases do you report per month?	3.187	0.076	0.428
Experience as a CHW was found to have an effect on OUP4, where $F(1, 357) = 8.76$, $p = 0.003$ *, partial $\eta^2 = .838$.				
OUP5	Of the households visited, how many referral cases do you report per month?	0.473	0.493	0.105
OUP6	In a typical week, how much time (in hours) do you take to complete reports for monitoring cases?	0.206	0.650	0.074
OUP7	In a typical week, how much time (in hours) do you take to complete reports for health promotion cases?	0.896	0.345	0.157
OUP8	In a typical week, how much time (in hours) do you take to complete reports for referral cases?	1.243	0.266	0.199
OUP11	What percentage of the reports completed are returned to you for additional information due to errors or inconsistencies?	0.339	0.561	0.089
Tool Use Experience was found to have an effect on OUP11, where $F(1, 357) = 5.95$, $p = 0.015$ *, partial $\eta^2 = .682$				

*** $p < 0.0001$ ** $p < 0.01$ * $p < 0.05$

In the early months of use, mHealth tool users reported fewer monthly cases completed on time compared to paper-based tool users. However, after five or more months of use, mHealth tool users reported significantly higher percentages than paper-based tool users.

3.3 Perceptual User Performance Differences

A descriptive comparison of mHealth and paper-based tool users along the 8 perceptual performance indicators (PUP1 – PUP8) was also carried out. **Figure 5** shows the means and confidence intervals for the two groups, where users show generally higher positive perceptions of mHealth tool use compared to paper-based tool use. Across all 8 measures, mHealth tool users report greater satisfaction with the tool's performance impacts. Moreover, confidence intervals do not overlap, thus providing support for the perceived effect of mHealth tool use on performance. Users of mHealth tools are clearly more satisfied on average with the contribution of the tool to their performance. This satisfaction is important in a context

such as this, having been shown in past work to critically determine success related to use of information systems [30, 31, 32, 16] the belief that systems meet users information requirements [33], or the affective attitude of users as they interact with systems [30].

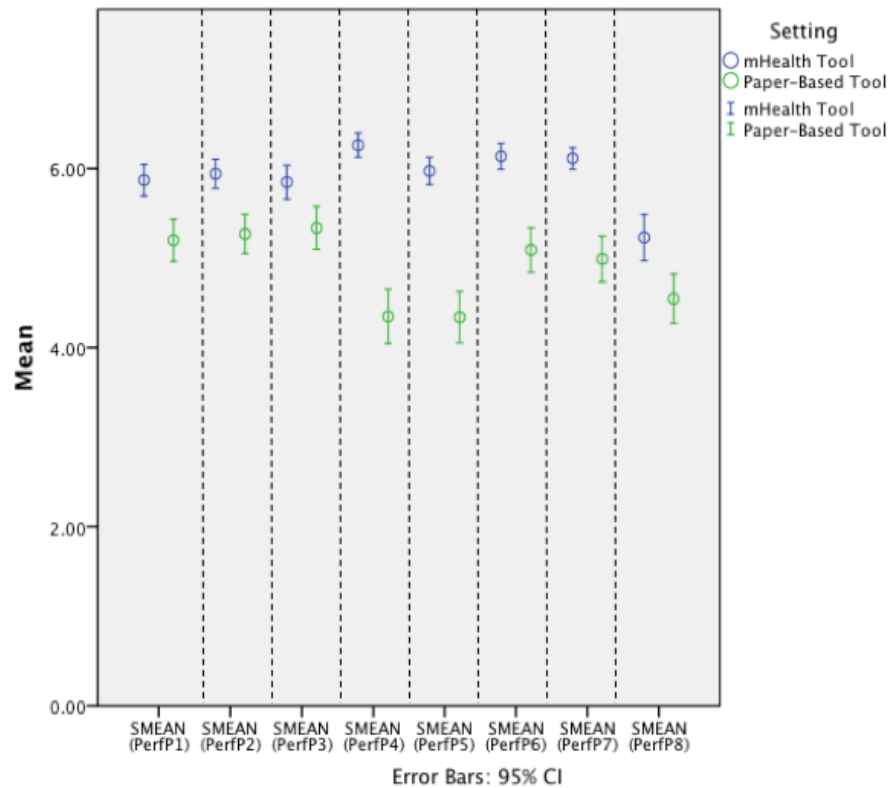


Figure 5. Perceptual Performance means with 95% confidence intervals

4 Discussion

Users of the mHealth tool have shown higher levels of satisfaction with the tool's contribution to performance than paper-based tool users across all perceptual indicators examined. By using mHealth tools, CHW's also achieve superior performance along more objective indicators, which reflect enhanced levels of reporting of healthcare service tasks. In particular, they report higher percentages of monthly cases on time and without missing data. In addition, findings also suggest that mHealth tool users may initially be more sluggish with use than their paper-based counterparts, but eventually gain enough experience with the mHealth tool to report higher percentages of monthly cases completed on time. Initial productivity dips at the early stages of an IT intervention are not uncommon, given that users need time to adapt to a particular tool use setting before performance benefits are fully realized [15]. This study's results provide much needed evidence of mHealth impacts on CHW performance outcomes. Our results are generally positive that mHealth can assist health workers to better serve their communities and link them with the broader healthcare system.

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References

- [1] Mechael P, The Case for mHealth in Developing Countries. *Innovations*. 2009; 4(1):103-18.
- [2] One Million Community Health Workers: Technical Taskforce Report. Earth Institute [Internet]; 2010 [cited 2015 Feb 24]. Available from http://milleniumvillages.org/uploads/ReportPaper/1mCHW_TechnicalTaskForceReport.pdf
- [3] Liu A, Sullivan S, Khan, M, Sachs S, Singh P. Community Health Workers in Global Health. Scale and Scalability. *Mt Sinai J Med*. 2011; 78(1):419-35.
- [4] LeMaire J. Scaling Up Mobile Health: Elements for the Successful Scale Up of mHealth in Developing Countries. Geneva: Advanced Development for Africa [Internet]; 2011 [cited 2015 Feb 24]. Available from http://www.k4health.org/sites/default/files/ADA_mHealth%20White%20Paper.pdf
- [5] Harris A, McGregor J, Perencevich E, Furino J, Zhu J, Peterson J, et al. The Use and Interpretation of Quasi-Experimental Studies in Medical Informatics. *J Am Med Inform Assoc*. 2006; 13(1):16-23.
- [6] Cook T, Shadish W, Wong V. Three Conditions Under Which Experiments and Observational Studies Produce Comparable Causal Estimates: New Findings from Within-Study Comparisons. *J Policy Anal Manage*. 2006; 27(4):724-50.
- [7] Leedy P, Ormrod, J. *Practical Research: Planning and Design*. New Jersey: Pearson; 2013.
- [8] Creswell J. *Research Design. Qualitative, Quantitative, and Mixed Method Approaches*. California: Sage Publications; 2014.
- [9] Goodhue D, Thompson R. Task-Technology Fit and Individual Performance. *MIS Quarterly*. 1995; 19(2):213-36.
- [10] Goodhue, D. The Model Underlying the Measurement of the Impacts of the IIC on the End Users. *J Am Soc Inf Sci*. 1997; 48(5):449-53.
- [11] D'Ambra J, Wilson C. Use of the World Wide Web for International Travel: Integrating the Construct of Uncertainty in Information Seeking and the Task-Technology Fit (TTF) Model. *J Am Soc Inf Sci Technol*. 2004; 55(8):731-42.
- [12] Teo S, Men B. Knowledge Portals in Chinese Consulting Firms: A Task-Technology Fit Perspective. *European Journal of Information Systems*. 2008; 17(1):557-74.
- [13] Cane S, McCarthy R. Analyzing the Factors that Affect Information Systems Use: A Task-Technology Fit Meta-Analysis. *Journal of Computer Information Systems*. 2009:108-23.
- [14] D'Ambra J, Wilson C, Akter, S. Application of the Task-Technology Fit Model to Structure and Evaluate the Adoption of E-Books by Academics. *J Am Soc Inf Sci Technol*. 2013; 64(1):48-64.
- [15] Belanger F, Collins R, Cheney P. Technology Requirements and Work Group Communication for Telecommuters. *Information Systems Research*. 2001; 12(2):155-76.
- [16] Hou C. Examining the Effects of User Satisfaction on System Usage and Individual Performance with Business Intelligence Systems: An Empirical Study of Taiwan's Electronics Industry. *Int J Inf Manage*. 2012; 32(6):560-73.
- [17] Junglas I, Abraham C, Ives B. Mobile Technology at the Frontlines of Patient Care: Understanding Fit and Human Drives in Utilization Decisions and Performance. 2009; 46(3): 534-647.
- [18] Torkzadeh G, Doll W. The Development of a Tool for Measuring the Perceived Impact of Information Technology on Work. *The International Journal of Management Science*. 1999; 27(1):327-39.
- [19] Arango J, Iyengar M, Dunn K. Performance Factors of Mobile Rich Media Job Aids for Community Health Workers. *J Am Med Inform Assoc*. 2011; 18(1):131-37.
- [20] Hair J, Babin B, Money A, Samouel, P. *Essentials of Business Research Methods*. Chichester: Wiley; 2003.
- [21] Saunders M, Lewis P, Thornhill A. *Research Methods for Business Students*. Edinburgh Gate, Harlow: Pearson; 2012.
- [22] Daniel J. *Sampling Essentials: Practical Guidelines For Making Sampling Choices*. California: Sage; 2012.
- [23] Vanderstoep S, Johnston D. *Research Methods For Everyday Life, Blending Qualitative and Quantitative Approaches*, California: Jossey-Bass, San Francisco; 2009.
- [24] Gopalan S, Mohanty S. Assessing Community Health Workers Performance Motivation: A Mixed-Methods Approach on India's Accredited Social Health Activists (ASHA) Programme. *BMJ Open*. 2012; 2(5):1-11.
- [25] Ndedda C, Wamae A, Ndirangu, M, Wamalwa D, Wangalwa G, Watako P, et al. Effects of Selected Socio-Demographic Characteristics of Community Health Workers on Performance of Home Visits During Pregnancy: A Cross-Sectional Study in Busia District, Kenya. *Glob J Health Sci*. 2012; 4(5):78-90.
- [26] Kruk M, Freedman L. Assessing Health System Performance in Developing Countries: A Review of the Literature. *Health Policy*. 2008; 85(1):263-76.
- [27] Hair J, Black W, Babin B, and Anderson R. *Multivariate Data Analysis*. New Jersey: Prentice Hall; 2010.
- [28] Brace N, Kemp R, Snelgar R. *SPSS for Psychologists*. Hampshire: Palgrave Macmillan; 2012.
- [29] Ruland C. Handheld Technology to Improve Patient Care. *J Am Med Inform Assoc*. 2002; 9(2):192-201.

- [30] Doll W, Torkzadeh G. The Measurement of End-User Computing Satisfaction. *MIS Quarterly*. 1988; 12(2): 1151-71.
- [31] Igarria M, Tan M. The Consequences of Information Technology Acceptance on Subsequent Individual Performance. *Information and Management*. 1997; 32(3):113-21.
- [32] Ives B, Olson M, Baroudi J. The Measurement of User Information Satisfaction. *Commun ACM*. 1983; 26(10):785-793.
- [33] DeLone W, McLean E. Information Systems Success: The Quest for the Dependent Variable. *Information Systems Research*. 1992; 3(1):60-95.

Good practices to enhance the perceived usefulness of computerized hospital information systems – case study in Nigeria

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Background and Purpose: Information systems that are not perceived useful, might not be used optimally. This can be seen as a waste of valuable resources and investments. The theoretical objective of the study was to see how Hanmer's Model of Computerized Hospital Information System (CHIS) Use and Perceived Usefulness could be applied in a case in Nigeria. The practical objective was to build experiences of usefulness into good practices to motivate further CHIS use.

Methods: Hanmer's model of CHIS use, developed and validated in South Africa, was used as a framework for this qualitative empirical case study. In-depth thematic interviews with clinicians (N=8), medical records officers (N=6) and hospital administrators (N=5) were conducted in spring 2011 at two Nigerian hospitals. Combinations of deductive and inductive content analysis were applied.

Results: The narratives of the respondents (N=19) fit into Hanmer's categories of *Knowledge and understanding about CHIS*; *Appropriateness of design*; *Performance*; *Availability and allocation of resources*; *Management commitment to success*; and *Effective use of CHIS outputs*. However, poor infrastructure, interrupted power supply, political and cultural climate, historical aspects and environmental issues such as dust, moisture, heat, and compromised work ergonomics repeatedly emerged.

Conclusions: A new category *Acknowledgement of the environmental context* is proposed. As a practical contribution, 58 good practices to enhance the perceived usefulness of CHIS were retrieved from the narratives. Examples include adhering to the system hardware and network requirements, maintaining on-site technical staff and service contracts, involving different professional groups in ICT projects to initiate ownership of projects, and developing solutions for long-term archiving. These could be helpful not only to motivate the effective use of the current CHIS implementations and to lengthen the life cycle of systems in a sustainable manner but also to be utilized in future CHIS implementations.

Keywords: Computerized hospital information system, Perceived usefulness, Hanmer's model, Nigeria

1 Introduction

1.1 ICT in health care in Africa and Nigeria

Since the 1990's, the trend to deploy information and communication technology in the health care setting in order to strengthen and modernize health services has been growing globally. There is a significant increase in the efforts made in many developing countries including sub-Saharan Africa to develop health care by improving the documentation, statistics and work practices and thus to manage

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vulnerable resources with ICT. In the past many Nigerian hospital information systems have been robust, non-commercial and often developed by the local universities and university hospitals. The diffusion and usage of computers in Nigeria has been fairly low in the past because PC costs were too high for an average Nigerian. Currently the technology sector of Nigeria, especially in mobile solutions, has been rated the fastest growing in Africa. [1]

With a population of 160 million people, Nigeria has approximately one-sixth of Africa's population. Africa's most populous country faces enormous infrastructural challenges [2]. It has been stated that any country that finds it difficult to provide uninterrupted power supply for its citizens will have problems with the deployment of good ICT services, including ICT in health care [1].

An interest in computer literacy, technology acceptance capacities, the attitudes of health professionals and other stakeholders in the health sector in developing countries demonstrate a need for change [3]. The arrival of computer systems and technology in many sub-Saharan countries preceded the availability of computer skill and knowledge in the educational system. Many health professionals and health policy makers who graduated before the late 1990s received little formal training in computer or internet usage during their studies. Even those who had applied ICT to healthcare systems do not always get the maximum benefit from ICT advancements due to both inadequacies in data quality and a lack of data utilization [4, 5]. Research on Nigerian users' experiences in deploying ICT and their perceptions of ICT usefulness for their work, their patients and organizations is scarce.

In this study the term *information systems* is understood in the way that Alter [6] defines it and Mursu et al. [7] use it: work systems, the processes and activities of which are devoted to processing information: capturing, transmitting, storing, retrieving, manipulating, and displaying information. The work system itself is a system, where people on their own or together with machines performs work activities using information, technology and other resources to produce specific products or services for specific internal or external customers. Health care related ICT is exemplified in computerized hospital information system (CHIS), which typically consist of patient admission, discharge and transfer modules, billing, laboratory data and e.g. clinical information and order entry modules of medication and other treatment and therapies. Electronic medical records (EMR), electronic patient records (EPR), radiology information systems (RIS) and picture archiving and communication systems (PACS) [8, 9] are also types of CHIS.

People tend to use or not to use an ICT application or information system based on the extent that they believe it will help them to perform their job better. This phenomenon is called *perceived usefulness* [10]. It has been proposed that perceived usefulness influences the *user acceptance and usage behavior* of the user acceptance of information technologies in general [11]. *Usefulness* and *utility* can be seen also as steps on the way toward practical acceptability and full system acceptability. Usefulness means that the user feels he or she can use the system in order to achieve some desired goals [12]. Thus information systems that are not useful might not be optimally used. This can be viewed as waste of valuable resources in any economy. This is especially true in the case of developing countries or any environments where the resources are scarce [13, 14]. Hence it is feasible to examine and understand how users perceive the usefulness of information systems.

The theoretical objective of this study is to see how Hanmer's model of computerized hospital information system use [14] fits into Nigerian cases. The practical objective is to assess the experiences of usefulness and how they could be built into good practices to motivate CHIS use.

1.2 Hanmer's conceptual model of computerised hospital information system (CHIS) use

Lyn Hanmer [14] has developed and validated a conceptual model of CHIS use in the South African health care setting. On the hospital level, Hanmer identified six factors (Figure 1) contributing to the perception of usefulness and thus influencing the successful implementation and use of CHIS: 1) *Knowledge and understanding of information system*; 2) *Appropriateness of design*; 3) *Performance*; 4) *Allocation and availability of resources*; 5) *Management commitment to ensure success*; 6) *Effective use of CHIS and/or outputs*. Decisions on information system and health ICT application investments, implementation projects and roll outs in South Africa are launched at the level of provinces based on the ICT policy – individual health care facilities are not in the position to be involved in the decision making on which systems to implement.

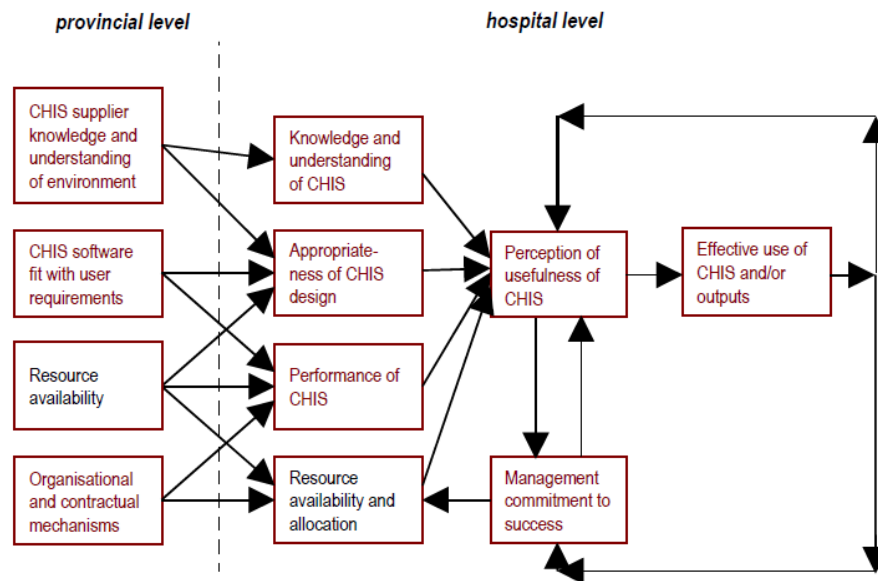


Figure 1. Hanmer's conceptual model of CHIS use [14]. Only the hospital level was used in this study in Nigeria.

In Nigeria, there are three tiers of government responsible for health care: Federal, State and Local government [15]. The individual health care facilities make decisions about the ICT to implement, thus a modified version of Hanmer's model was used as a framework for this study, with the hospital level assessment only.

In his paper on the barriers to the adoption of hospital information systems in Nigeria, Ayodele [16] [17, 18] suggests that government policies might constitute the major barriers hindering the adoption of hospital information systems in Nigeria. The heterogeneous solutions might explain the interoperability and integration challenges of various implementations described in literature [15, 19] resulting from the tradition of individual hospital deciding on which systems to purchase and implement.

2 Materials and methods

2.1 Research design

The research was designed as a qualitative single case study with an interpretive approach. The case study approach was selected because the particular CHIS application that had been developed by Nigerian and Finnish researchers in collaboration provided existing contacts in Nigeria and thus access to CHIS users in this environment. The empirical part, in the form of data collection through thematic in-depth interviews of CHIS users was conducted in Nigeria during spring 2011, during a three month North South South student exchange period of the first author dedicated to MHS thesis writing [20]. Hanmer's model of CHIS use was selected as a framework for the study due to it being developed in an African country and thus having some potential to be applied in Nigerian context, too. It was acknowledged that Nigeria and South Africa might differ, e.g. concerning infrastructure and health service delivery system, but Hanmer's model was seen worth experimenting on as a framework rather than using a framework developed and tested outside Africa.

The six themes of Hanmer's hospital level model (Figure 1) were used in the interviews. Also, the respondents were asked to provide basic demographics and evaluate on a scale of one to five how useful they saw the CHIS for their work at the time of the interview.

The approval for the study was obtained from the Chief Medical Directors and Nursing Managers of the two hospitals. The two hospitals were both purposively and convenience selected out of the eight hospitals using the CHIS in question. Hospital A had been using the CHIS since the beginning of 1990's and was selected because of accessibility. Hospital B, much further north from hospital A, had been using CHIS since the mid 1990's and, as described by the software package developers, demonstrated the most extensive use of different modules and functionalities of the CHIS. The confidentiality and use of data for

academic purposes was explained to the management of the organizations when interview permits were obtained through the existing local connections of the researchers. The participation to the interview was voluntary. Informed consent was confirmed verbally from each respondent when the study was explained to the interviewees. It was made explicit the thematic interview is not to assess or to evaluate the use of CHIS or compare institutions and there would be no right or wrong way to describe usefulness. The interviewees could withdraw from the interview at any time. All respondents were professional adults. Some of them were not willing to share demographics like age, educational or ethnic background, so this information is excluded from results. They were assured that once digital recordings were transcribed into text, the recordings would be erased and only transcripts which did not have any identification would be stored and analyzed.

The protocol did not require a clearance from a hospital ethical commission or equivalent because patient data was not handled. The selection of the different professionals for the interviewees at the hospitals was done by the managers and CHIS system administrators purposefully as instructed by the researchers based on the insight and interest in the topic. In purposeful sampling people, organizations and communities are selected because they are information rich and provide a useful insight of the phenomenon of interest. Selection is aimed deliberately at individual experiences on the job and the intention is not to generalize from the sample of population [21]. Out of digitally recorded thematic interviews 146 pages of narratives of usefulness were transcribed.

2.2 Research environment and the case CHIS

The case software is one of the first CHIS in Nigeria and locally developed since the 1989. It is a result of the information management needs of a hospital's medical records staff and taken as a joint project of Nigerian and Finnish researchers and the local teaching hospital staff [22]. The objective was to develop a low-cost application with sustainable, indigenous capabilities. Public-domain software developed by the U.S. Department of Veterans Affairs (VA) and its Admission-Discharge-Transfer package was used as the basis and the requirements of the local hospital were processed to suit the information management practices [22, 23, 24, 25].

The original plan was to not only market the software to all teaching hospitals in Nigeria but later possibly introduce it as a commercial product to other areas, too. However, some interested potential customers were in the opinion that the package was not yet at that time ready for large commercial release as the hospital testing was not extensive enough [1]. Later there have also been some discussions between the developer team and the test hospitals on how the pricing, marketing, services and maintenance should be organized [25].

Although the commercialization of the software package might have been slow, new modules and functions have been continuously developed based on user requests over the years. The technical architecture of the first version was originally based on the MUMPS language, FileMan database management system, and Kernel software platform [24, 26]. Since then the software architecture and database structure has been modernized several times. Currently this CHIS is implemented in eight federal hospitals in Nigeria. At the time of the data collection, version number 3.0 was going through a complete re-engineering to produce the next generation thin browser-based user interfaces. The application will be accessed through browser by clinical staff, medical records personnel and administrators. At the time of the interviews, a Java platform was planned to be the backbone of the system. Each hospital would have dedicated servers in the hospital premises running the system and the databases. User consoles would connect to the server through intranet. Besides, the server could be connected to the Internet, enabling remote access from anywhere that there is Internet connectivity [20, 26].

2.3 Data analysis

Both inductive and deductive content analysis methods were applied. Deductive content analysis was used when the interest was to see if Hanmer's model will accommodate the topics retrieved from the narratives of Nigerian CHIS users, thus in a new environment. Inductive content analysis was used when looking for patterns, themes and categories in the data to allow new insights to emerge inductively from

the data. This inductive analysis method was used to group together common themes of usefulness when building the good practices to enhance usefulness.

Figure 2 demonstrates an example of an inductive phase of analysing how the original expressions of interviewees were step by step formulated into good practices. Original expressions from digital recordings transcribed into text were first summarized, then built into sub-concepts and further grouped into good practices. This was done by using the categories of *Knowledge and understanding of CHIS*, *Appropriateness of design*, *Performance*, *Availability and allocation of resources*, *Management commitment to success*, and *Effective use of CHIS outputs*.

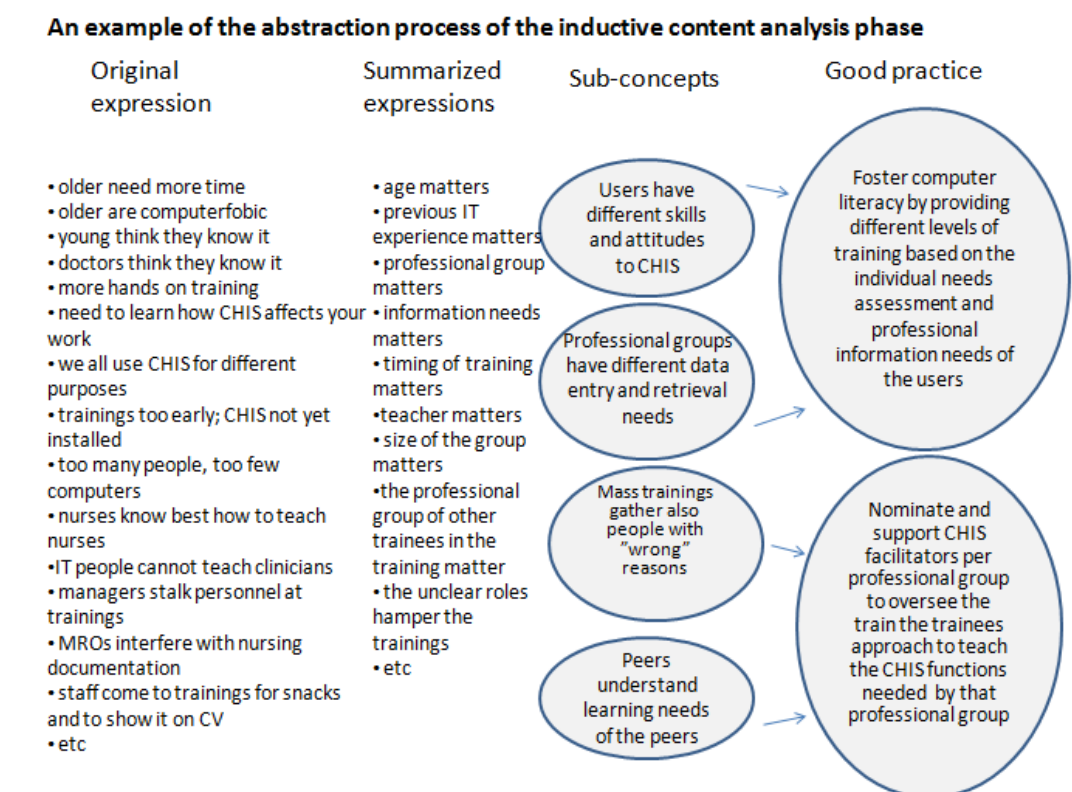


Figure 2. An example of the inductive content analysis abstraction process on how a good practice to enhance the perceived usefulness of CHIS was retrieved in the category of *Availability and allocation of resources*.

3 Results

3.1 Narratives and how they fit into Hanmer’s original categories

The respondents (n=19) consisted of nurses (4), doctors (4), medical records officers/information officers (6), representatives of managements and administrators (4) and a software developer of the CHIS. There were 15 male and 4 female informants. All but one had been using CHIS at least at some point during their work routines; 15 of them currently actively. All medical records officers used CHIS every day. Computer literacy and CHIS use was achieved through a combination of self-study and learning on the job. All but one respondent had a computer at home. Respondents stated that there were tailored CHIS end user trainings for different hospital employee groups, but the trainings might be at irregular intervals.

The current mean overall score of usefulness of CHIS given was 2/5. Respondents voluntarily wanted to explain that the CHIS usefulness was 4/5 in the mid 1990’s, but it had deteriorated gradually over the years. Issues with data quality and maintenance problems were stated as the main reason why the overall score of perceived usefulness had been decreasing. As estimated by both the hospital top management and by the developer, due to these challenges only 20-40 percent of personnel used the CHIS at the time of the interviews in 2011. The CHIS was used mainly for the Admission, Discharge and Transfer (ADT)

functions, mostly handled by the medical records officers, including the documentation of patient diagnosis by using ICD-9. Also, some nursing documentation was conducted at both case hospitals, but there were still wards without computers. The core of the patient file was in paper format at both sites. It was explained by the administrators and management of both hospital A and B that institutions had not yet planned to stop using the paper documentation because paper is still the juridical form of a patient document.

The interviewed physicians explained that the majority of physicians are using only the manual paper based information system or tailored databases on their own laptop computers. The interviewed physicians thought CHIS is not reliable and stable enough due to power blackouts and network challenges. Some medical records officers (MROs) acknowledged that data on the CHIS database might not be complete because of parallel manual and electronic information systems and the isolated data repositories of physicians. MROs also explained that they dedicate a considerable amount of time in transferring patient information from paper files to the CHIS for statistics e.g. at the patient discharge time, because physicians are reluctant to enter diagnoses to the CHIS. In practice, MROs feel that they end up maintaining two information systems, the manual paper based documentation and the CHIS, to guarantee a good quality of statistics.

It was brought up by several MROs that in the beginning of 1990's the statistics were easily retrievable from the CHIS whereas now it was again done partly manually to re-check data quality. Increasing the number of computers in wards and modernizing and improving the hospital network system has been done in sync and per hospital IT strategy, yet staff voiced out their concern that the network would not tolerate more users at this point. An inadequate number of licenses for simultaneous users was suspected to cause some of the problem. When having no access to the network, clinicians and MROs had to rely on paper documentation and then once the network was up again, they had to remember to document the same data into the CHIS. Sometimes they forgot – or had no time to do so.

There were two clear layers in the narratives: on the one hand the potential and theoretical usefulness of any given CHIS in general or in future as a “dream CHIS”, and on the other hand the usefulness of the current CHIS. Especially two interviewed super-user nurses who also train others and run the computer club for nurses, were well aware of the capabilities of the current system and the growing potential of it once used extensively:

“CHIS is a powerful tool to improve our patients care and our work, too. We should see it as an achievement, not as a burden.”

“It has been proved scientifically in many studies, that the number of errors is reduced when computerized systems are being introduced because notes and prescriptions are more legible. You continue data collection and utilization from where the previous staff member finished: continuity of health care. So another important feature of usefulness is the support for our workflow.”

However, not all clinicians were as convinced of the usefulness of the current implementation, targeting their criticism not towards the software package and design but rather towards infrastructure:

“When the lights go off and you are in the middle of documenting something, you are never 100 percent sure how much of that was saved even if the generators would start immediately. And they do not.”

Especially physicians were concerned and expressed frustration because of the gap between the expected usefulness of the CHIS implementation and the reality. Maybe if the ICT strategy and computerization plan of the hospitals were shared with the staff, some of the frustration could be voiced out to the right address:

“We are 75 % paper and 25 % electronic. It is inefficient. We need to computerize. Current system needs to be utilized more, in a structured manner. Now we are not sure if the data is complete.”

Clinical usefulness was experienced to be compromised because nurses have their nursing module and assessment sheets, whereas physicians did not seem to have support for their work activities in the same way. Or maybe their user requirements were still in the list of new features to be designed for the future versions but the status of the needed feature did not reach them for a reason or another:

“Medical progress notes or a case note module would be the most to us. Currently it just does not yet support the doctors’ work flow here. Progress notes should be available simultaneously by different professionals when needed.”

Even in the case of the current CHIS, two basic types of narratives of usefulness were reported: how useful the system was in the beginning in the 1990’s after the initial implementation, and how useful it is now. The breaking point of usefulness, described by the ones who had been using CHIS from the very beginning of the development, had taken place some three-four years earlier as what the interviewees understood as a combination of uncoordinated software version updates and a lack of maintenance culture. After that, data entry and retrieval problems started to appear more frequently. The concern for data quality was the most frequently mentioned threat to usefulness regardless of the professional group of the interviewee.

Many of the issues mentioned affecting the perceived usefulness of CHIS were not directly due to the design of the CHIS software package. Especially the users who had a long history of using the system, actively brought up that the design was not the reason for the somewhat low perceived usefulness. Main reasons appeared to be the insufficient or unstable infrastructure, especially the power supply and network, the partly manual partly computerized HIS system and parallel health records, the data completeness and retrieval concerns, unclear responsibilities between clinicians and medical records officers, the lack of system integration, missing CHIS features causing a lack of support to the workflow, a lack of technical support and maintenance culture, and challenges in the collaboration with the developers.

3.2 New category: Acknowledgement of the environmental context

Although Hanmer’s model appeared to accommodate the narratives well, interviewees brought up repeatedly the issue of a developing country having special features that the outsider would not necessarily acknowledge. Some of those might affect the usefulness of a system which was known to be robust, reliable and easy to use. Users expressed that those issues should be taken into consideration when addressing the issue of perceived usefulness of applications and information systems in general in such an environment.

“Because we are in Nigeria, in one of these developing countries in black sub-Saharan Africa, we have our own unique problems. We must tackle also the infrastructure and environment when we discuss the concept of the perceived usefulness of it. Uninterrupted power supply is not self-evident.”

These themes relating to the environment and context were brought up most frequently by the hospital top management and administrative staff; less so by clinicians, medical records officers and CHIS developer. Many of these issues were associated with the physical, natural environment or the challenges of infrastructure, system maintenance or serviceability. The common concern was that the environment, especially in case of a developing country, in itself has some internal and external factors that the outsiders need to grasp in order to address and understand the concept of CHIS use and usefulness or when making assumptions about it. These themes, varying from straight forward climate issues to political instability and basic ICT education of staff, technical know-how and brain drain of medical and IT personnel to abroad, could not be accommodated comfortably in the previously existing categories of Hanmer’s framework. Thus, a new category of “*Acknowledgement of the environmental context*” could be proposed. Naturally, the proposed category requires further research.

When proposing the *Acknowledgement of the environmental context*, the term *environment* would, in addition to the natural environment, cover also the socio-political environment including historical and cultural phenomena explaining e.g. the challenges in infrastructure and the considerably new tradition of IT maintenance. Thus it becomes closer to the concept of *context*. Context can be seen as the entire human environment including culture, history, and natural environment. Scopes of context can be based on the anthropological definition of three layers of contexts: cultural context, historical context, and immediate context [27] [28]. In information system development the nature has to be taken into consideration to maintain durability, sustainability and the continuation of the system use to utilize resources to its best, thus the natural environment is added to the scopes of the context map.

The importance of the environment regarding to the appropriateness of information systems is not unique. For example Tiihonen [27] points out that partners and observers from different cultural and historical heritages, for example the first author of this paper as a Finnish-speaking white woman in a Nigerian health care setting, do not easily grasp the socio-technical features in ICT implementations in developing countries. For example the environment in the form of the natural environment or the historical events that have led to a certain situation and the tacit knowledge of the employees, is not easy to recognize by outsiders. Therefore the intention is by no means to generalize any of these findings based on the narratives of CHIS usefulness collected in the case sites.

However, it might be interesting to try to combine these acknowledgements of the environmental context and Hanmer's existing six categories of CHIS usefulness into one unified figure as attempted in Figure 3.

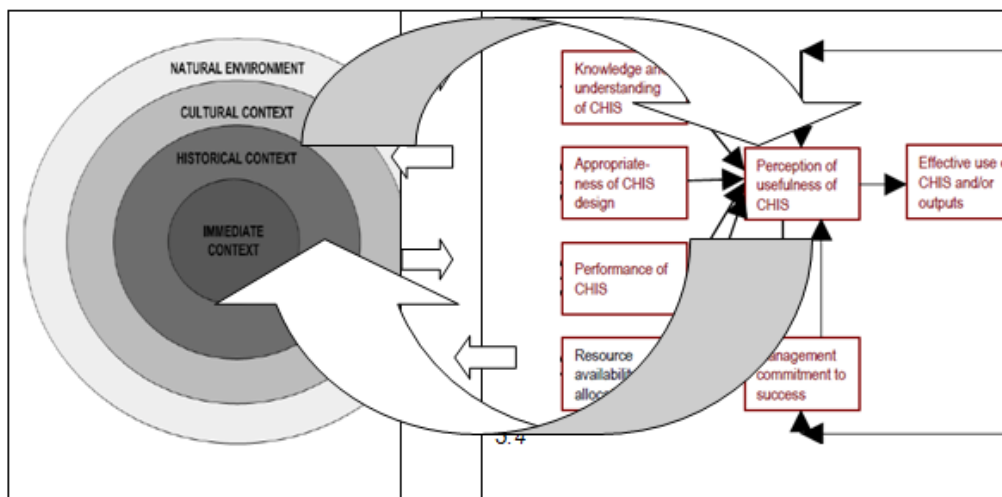


Figure 3. Continuous dialogue between the context and the perceived usefulness. Adapted from [27] and [14].

The different layers of context from immediate to historical, cultural and up to the natural environment embrace the immediate health care and hospital settings of CHIS use and the experience of usefulness. The health work and health information processing activities conducted in the immediate context of the hospital setting with the help of the CHIS are always surrounded by and dependent on the historical and cultural contexts and at the end of the day always surrounded by the natural environment which gives the extra challenges to ICT, whether in Nigeria or in Iceland.

The narratives of the interviewees can also be accommodated into Tiihonen's [27] different layers of context and cross-cutting sectors of organizational culture, infrastructure, economy, human resources and social-political structure. There is a continuous dialogue between Tiihonen's LACASA approach and Hanmer's model. The conclusion might be that they complement each other as proposed in Figure 4.

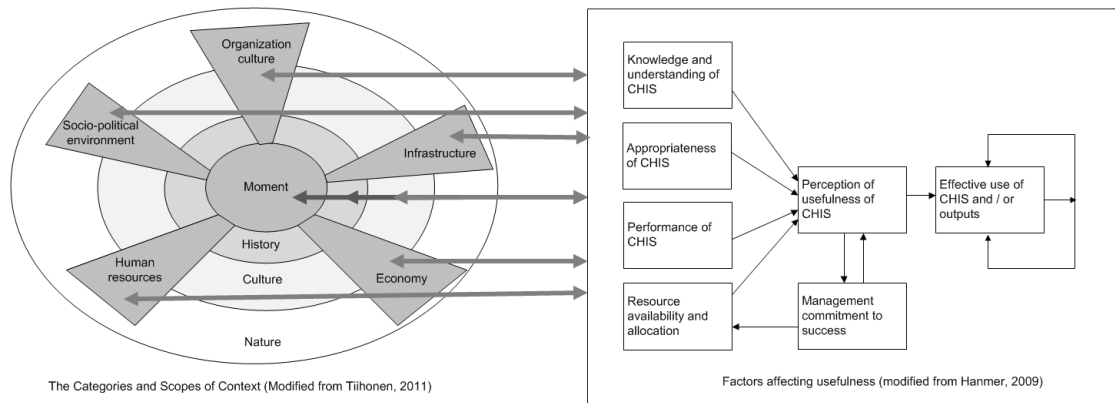


Figure 4. The relationship between Tiihonen's LACASA approach and Hanmer's model. The new factor *Acknowledgement of the environmental context* could enhance Hanmer's model.

The acknowledgement of the overall environmental context can be seen as a prerequisite to any successful ICT use and perceived usefulness. The developing country context and the resource restricted environment came up repeatedly in the narratives, thus the new category of *Acknowledgement of the environmental context* could be considered to enhance Hanmer's model.

3.3 Good practices to enhance the experiences of usefulness and to promote the more extensive use of CHIS

Altogether 58 good practices as how to enhance the experiences of usefulness could be derived from the narratives. Good practices include practical issues such as adhering to system hardware and network requirements, procuring service and maintenance contracts, working on data completeness, collaboration with developers and a national user club, a "train the trainers" methodology, recognition and incentives to CHIS facilitators, and communicating system integration based on ICT strategy.

All the 58 good practices are presented in the Appendix. The new category of *Acknowledgement of the environmental context* is discussed in more detail here. The main type of a good practice in *Acknowledgement of the environmental context* is to develop and maintain policies, protocols and routines to prepare for unwanted and unexpected scenarios (see Table 1).

Some of the good practices are directly related to the physical natural environment (e.g. moisture, sand, rain, floods), some of them to infrastructure (erratic electricity, blackouts, need for surge protectors), some to economic and political instability (potential strikes, violence, riots, even terrorism). Also, some good practices in this category do not necessarily at first glance appear to be associated with the environment. The respondents brought these challenges in their narratives as something typically taking place in resource constricted environments: rapid staff turnover, difficulty in hiring skilled personnel due to the brain drain of trained IT staff and clinical staff to private business or emigration to better paid positions in the US or Europe were voiced and ideas on how to retain and recruit skilled staff were initiated.

One could of course argue that many of the good practices in the category of *Acknowledgement of the environmental context* could also be squeezed into some of the existing categories of Hanmer's model. However, I believe presenting them together as special features resulting from the unique combination of the natural environment, cultural, historical and immediate contexts in a developing country would give an outsider at a glance some understanding of the challenges of the CHIS use in the developing country settings.

"The software itself is and could be useful – this is all now due to local technical challenges, infrastructure and miscommunication."

"We do not want to give up. We have invested so much – work, time, funds. We cannot afford to abandon it. We have had a beautiful project. We'll show that we can take care of this and make this work, make it even better."

Table 3. Good practices to enhance the usefulness in the category of Acknowledgement of environmental context

Good practices: Acknowledgement of environmental context	
1	It is acknowledged that the software applications and solutions developed abroad are not necessarily applicable to the local needs and requirements as such but need local tailoring.
2	Robust, easy to maintain and locally developed open source software applications and solutions to hospital information system portfolio are favored.
3	The importance of remote access IT maintenance and service to get quicker service in areas out of reach is communicated with the developers and service providers.
4	(Policy how to protect the servers and workstations from excessive moisture, heat, dust, particles of sand etc during seasons of rain and <u>harmattan</u> is maintained.
5	Policy of protecting the computers and network switches from surge during irregular power service by providing adequate number of surge protectors is in place.
6	(Policy of adequate number of generator / generator farms and fuel reservoir to ensure uninterrupted power supply during electricity breaks and strikes is in place.
7	Risk assessment plan and protocol how to run information system in case of violent political conflict, riot or a catastrophe, which might produce large number of admissions in a short time is in place, is in place.
8	Risk assessment plan and protocol how to run information system in case of natural disaster is in place.
9	Policy how to operate CHIS during strikes of clinical and technical staff when hospital operations are run with minimum staff is in place.
10	Policy how to operate during strikes that affect to the availability of electricity, fuel and service delivery of other basic supplies needed at hospital is in place.
11	Retention plan for staff turnover and brain drain of ICT experts to private businesses and overseas due to of attractive job prospects and better pay is in place.
12	Staff recruiting and retaining policy that utilizes CHIS as one of the magnet hospital feature to call forth new hires is advertized.

The respondents did not use phrases such as “reluctance to use” or “resistance to change” – all in all there appeared to be a strong commitment to use the CHIS even after hiccups. Many of the big obstacles appeared to lie in the layers of the immediate, cultural, historical, and environmental context rather than in Hanmer’s categories of *Knowledge and understanding about CHIS*, *Appropriateness of design*, *Performance*, *Availability and allocation of resources*, *Management commitment to success* or *Effective use of CHIS outputs*.

4 Discussion

The narratives of 19 respondents as concerning the experiences of CHIS usefulness accommodated the categories of Hanmer’s model of CHIS use fairly well. Additionally, a separate category of *Acknowledgement of the environmental context* was proposed to be considered. Further study will be required to see if this category of the environmental context is applicable to other cases, too. Also, as stated earlier, no generalization to the Nigerian context or any other developing context can be made based on these findings. This is merely an attempt to understand the factors that might have an effect on the experiences of the usefulness of ICT in health care, in this case the usefulness of a CHIS, and thus might have an influence on the use of the system.

The findings in the study, however, are consistent with some of the observations in earlier research. The power supply and connectivity problems appear to be unavoidable in developing countries. Also, lack of maintenance culture and not yet having a tradition or resource to invest on service and technical support before problems arise can seriously damage the perceived usefulness when systems are down for hours or days [1, 13, 14, 16, 29, 30, 31]. In addition, if the ownership and control of the project in the beginning rests with the top level managers or external initiators but the professionals using the CHIS for their daily work have no feeling of being influential, it might be difficult for the end-users to build commitment to the project [30]. On the other hand, the experiences and attitudes of the interviewed CHIS super-user nurses and medical officers in these two hospitals supported Hanmer’s conceptual model: understanding and acknowledging the purpose and value of the CHIS and being ready to struggle to stabilize it will have an enforcing effect on the perceived usefulness. Despite of the pitfalls respondents

mentioned, they had a positive attitude. They continued to motivate their peers to use the CHIS through the train-the-trainers method. As noted also by Hanmer, if users believe that the CHIS is useful for them, they will make an effort to ensure that the system works and will also try to use the outputs of the system. On the other hand in case that the CHIS is not perceived as useful, the commitment becomes compromised and users might want to neglect the correct use of the system. This might have been the case of some of the interviewed physicians, who expressed that they would rather use their own, separate databases for their research data because at times they did not trust 100% on the data on the CHIS. This vicious circle of partly documenting patient data on some other systems whether paper based or electronic, could then in the long run result in challenges to data completeness.

Still, it has to be taken into consideration that even with the hospital's greatest interest and commitment to take action on some of the challenges brought up by the users in this study and the good practices formulated based on their experiences, it might not be realistic simply because of the lack of funds, resources and qualified, affordable ICT personnel. This is a complex challenging situation between the CHIS users, hospital leadership and developers where everybody still is working towards a mutually satisfying solution. The re-engineering of the platform and database structure and the all-in-all usability optimized software package has been developed and deployed to these interview sites, so currently the experiences of usefulness and the level of use might be on a much higher level. At the same time hospital leaders and administrators have been looking for a balance between the manual paper-based documentation and full computerization. It would be interesting to go back now to assess the perceived usefulness.

Regarding the practical contribution of the study, 58 good practices were derived from the narratives on how to support the CHIS usefulness and use. Those good practices demonstrate the tremendous knowledge and commitment that the interviewed personnel have about the strengths that a CHIS has. Good practices can be helpful as such to motivate more effective use of current systems but also helpful in future implementations.

In the future it would be interesting to assess a CHIS project more profoundly from the procurement or in-house development process throughout the implementation and system maintenance phases to understand the life cycle of sustainable CHISs, not only in Africa but in any resource constricted environment.

Acknowledgements

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References

- [1] Idowu P, Cornford D, Bastin L. Health informatics deployment in Nigeria. *Journal of Health Informatics in Developing Countries*. 2008;2(1): 15-23. Available from <http://www.jhdc.org/index>
- [2] Nigeria: World Bank Country brief statistics. Available from <http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/AFRICAEXT/NIGERIAEXTN/0,,menuPK:368906~pagePK:141132~piPK:141107~theSitePK:368896,00.html>
- [3] Adeyoyin S, Imam A, Oladapo Y. Health workers' ICT literacy in a Nigerian University Teaching Hospital. *The Information Technologist*. 2009;6(2).
- [4] Simba DO, Mwangi M. Application of ICT in strengthening health information systems in developing countries in the wake of globalisation. *African Health Sciences*. 2004;4:194-198.
- [5] Uneke C, Ezeoha A, Ndukwe C, Oyibo P, Onwe F. Enhancing health policymakers' capacity to use information and communication technology in Nigeria. *Journal of Health Informatics in Developing Countries*. 2011;5(2):228-246. Available from <http://www.jhdc.org/index>
- [6] Alter S. Defining information systems as work systems: Implications for the IS field. *European Journal of Information Systems*. 2008. 17(5), 448-469.
- [7] Mursu A, Luukkonen I, Toivanen M, Korpela M. Activity Theory in information systems research and practice: theoretical underpinnings for an information systems development model. *Information Research*. Vol 12. No 3, April 2007. Available from <http://informationr.net/ir/12-3/paper311.html>
- [8] Coiera E. *Guide to Health Informatics*, 2nd edition, Hodder Arnold. Chennai. India. 2004
- [9] Kuhn KA & Giuse DA. From hospital information systems to health information systems. Problems, challenges, perspectives. *Methods Inf Med*. 2001; 40(4):275-87.

- [10] Davis FD. Perceived Usefulness, Perceived Ease of Use and User Acceptance of Information Technology. 1989. *MIS Quarterly* Vol. 13, Issue 3, pp. 319-340
- [11] Venkatesh V. Determinants of Perceived Ease of Use: Integrating Control, Intrinsic Motivation and Emotion into the Technology Acceptance Model. *Information Systems Research*. 2000. Vol. 11, No. 4, December 2000, 342–365.
- [12] Nielsen Jakob. Usability Engineering. Boston Massachusetts Academy Press. Boston. 1993-
- [13] Heeks R. Health information systems: Failure, success and improvisation. *International Journal of Medical Informatics* 2006 (75), pp. 125—137.
- [14] Hanmer LA. Factors Associated with the Successful Implementation of Computerized Hospital Information Systems in South Africa. Doctoral thesis. University of Cape Town. Cape Town. 2009.
- [15] Oluwagbemi O & Achimugu P.. Lack of Integration in Software Systems for Health Practitioners in Nigeria: The Way Forward. *Journal of Health Informatics in Developing Countries*. 2010 Vol.4 No.1. pp 47-51. Available from <http://www.jhdc.org/index>
- [16] Ayodele CB . Hospital information systems in Nigeria: A review of literature. *Journal of Global Healthcare Systems*, 2011, 1(3):1-26. Available from <http://jghcs.info/index.php/j/article/view/71>
- [17] Ayodele CB. Adoption of Hospital Information Systems in Nigeria. *Journal of Global Healthcare Systems*, 2011, 1(3): 1-38. Available from <http://jghcs.info/index.php/j/article/view/73/74>
- [18] Ayodele CB. Assessing barriers to Adoption of Hospital Information Systems in Nigeria. *Journal of Global Healthcare Systems*, 2011, 1(3): 1-33. Available from <http://jghcs.info/index.php/j/article/view/72>
- [19] Gambo I, Oluwagbemi O & Achimugu P. Lack of Interoperable Health Information Systems in Developing Countries: An Impact Analysis. 2011 Vol 5, No 1 pp. 185-196. Available from <http://www.jhdc.org/index>
- [20] Vainikainen V 2012. Perceived usefulness of a Computerized Hospital Information System (CHIS) in a developing country context – Case study in Nigeria. MSc. Thesis. Department of Health and Social Management. University of Eastern Finland. Kuopio. Finland.
- [21] Patton M. Qualitative research and Evaluation methods. 3rd edition. Sage Publications. USA. 2002
- [22] Makanjuola ROA, Daini OA, Soriyan HA & Korpela M. Low-Cost Hospital Informatics in Africa: The Ile-Ife Experience. MIE 1991 Conference Proceedings. In: Adlasing et al (Eds.) *Medical Informatics Europe 1991 Proceedings*, Springer-Verlag p. 111-115.
- [23] Daini OA, Korpela M, Ojo JO & Soriyan HA. The Computer in a Nigerian Teaching Hospital: First-Year Experiences. HELINA conference 1993. Ile-Ife. Nigeria
- [24] Korpela M. Moving a valuable heritage to the network computing architecture. Proceedings of the 1999 Annual HIMSS Conference, Atlanta, Georgia. Vol. 3, pp. 405-419.
- [25] Soriyan HA. A Conceptual Framework for information System Development Methodology for Educational and Industrial sectors in Nigeria. Doctoral dissertation. ObafemiAwolowo University. Ile-Ife. 2004
- [26] Päckilä T. Re-engineering of software architectures. A Case-study on a Nigerian Hospital Information System. M. Sc. Thesis. School of Computing. University of Eastern Finland. Kuopio. 2010
- [27] Tiihonen Tuija. Information Systems in Context. Building a Tool for Analysing Sociotechnical Context of Organizational Information Systems. PhD Dissertation. University of Eastern Finland. Kuopio. 2011
- [28] Tapaninen, A-M. Sosiaaliantropologian perusteet, Homepage of Helsinki Open University. 2005 Available at <http://www.avoin.helsinki.fi/Kurssit/sosAntr/materiaali/> [Course material, in Finnish]
- [29] Mengiste SA. Analysing the Challenges of IS implementation in public health institutions of a developing country: The need for flexible strategies. *Journal of Health Informatics in Developing Countries*, 2010 4(1), 1-17,. Available from <http://www.jhdc.org/index>
- [30] Avgerou C. Information systems in developing countries: A critical research review. *Journal of Information Technology*. 2008 23. 133-146.
- [31] Kimaro HC. & L. Nhampossa José. The challenges of sustainability of health information systems in developing countries: comparative case studies of Mozambique and Tanzania. *Journal of Health Informatics in Developing Countries* 2007. (1) No.1. pp. 1-10.

Appendix: Good Practices to Enhance the Usefulness of CHIS

TABLE 1: Good practices: Acknowledgement of environmental context	
1	It is acknowledged that the software applications and solutions developed abroad are not necessarily applicable to the local needs and requirements as such but need local tailoring.
2	Robust, easy to maintain and locally developed open source software applications and solutions to hospital information system portfolio are favored.
3	The importance of remote access IT maintenance and service to get quicker service in areas out of reach is communicated with the developers and service providers.
4	(Policy how to protect the servers and workstations from excessive moisture, heat, dust, particles of sand etc during seasons of rain and harmattan is maintained.
5	Policy of protecting the computers and network switches from surge during irregular power service by providing adequate number of surge protectors is in place.
6	(Policy of adequate number of generator / generator farms and fuel reservoir to ensure uninterrupted power supply during electricity breaks and strikes is in place.
7	Risk assessment plan and protocol how to run information system in case of violent political conflict, riot or a catastrophe, which might produce large number of admissions in a short time is in place, is in place.
8	Risk assessment plan and protocol how to run information system in case of natural disaster is in place.
9	Policy how to operate CHIS during strikes of clinical and technical staff when hospital operations are run with minimum staff is in place.
10	Policy how to operate during strikes that affect to the availability of electricity, fuel and service delivery of other basic supplies needed at hospital is in place.
11	Retention plan for staff turnover and brain drain of ICT experts to private businesses and overseas due to of attractive job prospects and better pay is in place.
12	Staff recruiting and retaining policy that utilizes CHIS as one of the magnet hospital feature to call forth new hires is advertized.

TABLE 2: Good practices: Knowledge and understanding of CHIS	
1	Staff knows the value of CHIS: what are the functions and benefits of CHIS for patient care, individual employee, organization and community.
2	Staff acknowledges CHIS could be more than an ADT admission-discharge-transfer module. Depending of the implementation and interoperability of systems, in addition to clinical data all operations in hospital could be part of CHIS and thus provide important information for decision making and planning.

TABLE 3: Good practices: Appropriateness of CHIS design

1	The features and modules of CIS support the workflow of the users.
2	Users are able to give feedback and request new features in a structured manner as per service and maintenance contract.
3	Developers maintain database of errors and user requirements. Decisions and schedules are communicated to the users.
4	All changes, new features and functionalities to clinical modules are hospital tested to ensure patient safety.
5	Developers ensure the continuity of information and sustainable IS development cycle by documenting all changes made to the CHIS.

TABLE 4: Good practices: Performance of CHIS

1	Hospital based on-site IT specialist maintains CHIS as per ICT strategy.
2	Continuous service and maintenance contracts of hardware, software and network are in place.
3	Minimum system hardware, network and virus protection and data security requirements provided by the developer are committed to.
4	Hospital maintains appropriate number of software licenses to guarantee successful simultaneous log in for users.
5	Hospital maintains uninterrupted power supply and network conditions.
6	Hospital formulates and shares a protocol how to handle power and network failure.
7	System Audit & Analysis protocol with Logbook and instructions how to contact CHIS facilitator, system administrator, in-house IT and developer depending on severity of the problem is in place.
8	Routine protocol of taking back up and database dumps at regular intervals in case database corruption or system failure and how to re-install the system from backup media is in place.
9	Procedure and protocol for long term e-archiving is in place.
10	Protocol for legacy data separation to warehouse database to enable adequate performance of the system is in place.
11	In case performance issues or incomplete data is suspected, the data input and retrieval queries to verify problem sources are tested by hospital IT and developers.
12	Developers and IT service organization maintain up to date installed base documentation with frequently asked questions (FAQ) database, Call Tracker and service delivery database

TABLE 5: Good practices: Availability and allocation of resources

1	Hospital based on-site IT specialist maintains CHIS as per ICT strategy.
2	More resources are allocated to units active in ICT strategy implementation to work as an example to other units.
3	Responsibilities of hospital IT department, in house IT specialists, Sys admins, CHIS facilitators / super users are communicated clearly to avoid overlapping tasks and parallel processes.
4	Incentives are initiated for individuals and units committed to the ICT strategy.
5	Adequate number of ergonomic work stations is provided in wards to ensure documentation of patient care in a timely manner.
6	Computer literacy of health professionals is fostered by providing different levels of training based on individual needs assessment and information needs of the professional
7	CHIS facilitators and super users are nominated and recognized per professional groups to give and oversee “train the trainers“ approach to teach the core functionalities and modules needed by that professional group.
8	Regular CHIS trainings with hands on use of applications to cover skill deficit due to staff turnover is organized.
9	Professional initiatives such as hospital based laptop clubs and internal user groups are encouraged on the hospital premises to motivate CHIS use.

TABLE 6: Good practices: Management commitment to ensuring success

1	Representatives of all professional groups are involved in formulating the ICT strategy to initiate ownership.
2	ICT strategy covers the future plans of migrating from paper based information system to the computerized system and the protocol for the transition period of double documentation.
3	ICT strategy is communicated to the professional groups and stakeholders: for example how integration and interoperability of systems change work practices.
4	Both external and internal motivation is fostered among professional groups to enhance CHIS use.
5	Positive feedback for individuals and groups committing to CHIS used is initiated in form of staff awards and nominations.
6	Participation to an ICT seminar or workshop is introduced as an incentive and reward.
7	Hospital encourages senior medical staff to act as role models in CHIS use.
8	Centralized trainings in the form of user meetings and workshops are organized to collect user feedback or share latest enhancements together with the developers.
9	A joint national CHIS user group with the developers is organized so share good practices.
10	Management works actively to change the impression of CHIS being a tool for medical records officers: CHIS is presented as a valuable tool for all professionals.

TABLE 7: Good practices: Effective use of HIS and outputs	
1	Users are trained to understand the importance of complete quality data input in order to retrieve quality data statistics.
2	Users are trained about the risks of maintaining separate, isolated, private databases.
3	Hospital maintains protocol how to document during system down time and how to transfer the manual documentation retrospectively to CHIS to guarantee data completeness.
4	Data retrieval training update is organized as per need to ensure retrieval of statistics.
5	Statistical, reporting, data retrieval and research query needs are communicated to and assessed with the help of IT service or the developer as per agreement.
6	Staff is encouraged to utilize HIS outputs in research papers and seminar presentations.
7	Success stories of effective decision making based on use of CHIS outputs are shared within the organization or in the community (e.g. in epidemiological planning).
8	To support the workflow of clinicians to create more effective use of outputs, more CHIS modules for active use based on ICT strategy will be introduced (e.g. Laboratory, Radiology and Pharmacy integration)

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The maternal healthcare landscape around Grabouw, South Africa: setting the stage for information systems development

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Background and Purpose: The purpose of the paper is to depict the most essential aspects of the “landscape” of authorities, organizations and service flows related with maternal healthcare from the viewpoint of the local communities in the small town of Grabouw in Western Cape, South Africa. Understanding the wider landscape is needed for understanding the “close-up” view of the maternal healthcare services and activities in place in Grabouw, which in turn is a prerequisite for co-designing ICT based tools for the caregivers.

Methods: The methodology for depicting information systems landscapes was applied in guiding the data collection and in analyzing the data. Data was collected from public sources (government documents, web sites, literature) and from administrators and educators with general knowledge..

Results: The geo-political structure around Grabouw consists of municipalities, districts, and the province of Western Cape within the republic of South Africa, all of which have elected structures with overall political authority. The structure of healthcare authority differs from the structure of political authority – the provincial Department of Health and not the local municipality is in charge of all healthcare facilities. The flow of healthcare services beyond Grabouw is defined by the referral system, which in principle is aligned with the political structure but is adjusted to particular geographic factors. Within the Grabouw community the service flow is guided by proximity of care and the preferred services.

Conclusions: The results show that it is vital to understand the ‘healthcare landscape’ and the context around maternal care in Grabouw. There is an overlap of geo-political and healthcare authority structures, and information systems developers need to aware in order to develop useful, effective and efficient ICT solutions. The landscape model has proven to be successful in understanding the different elements of a ‘landscape’ around a community.

Keywords: Landscape, Maternal healthcare, Community, Service flows, Information flows

1 Introduction

Understanding the community and the ‘landscape’ around it are some of the aspects that contribute to the success of Information Systems (IS) projects particularly in the healthcare sector. Often the developers of these information systems and software applications are confronted with a challenge of understanding who the users are and the landscape around them [1]. This goes beyond just naming the users but involves understanding what they do, the environment or the context they operate in and the challenges they are faced with. It is also crucial to understand the services that are available to the community and their flows, authority structures, different organizations around them and the users’ interaction with these.

Over the years maternal and child health has been a concern globally. Maternal and child mortality rates have seen a decline recently; however South Africa and other developing countries still have unacceptably high maternal, newborn and child mortality rates [2]. In order to reduce these problems and

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also to improve maternal healthcare, the South African healthcare sector is introducing, using, and adopting of information and communication technologies (ICTs) [3]. There is a significant number of other ICT for health initiatives currently deployed throughout the country [4]. Mothers and maternal health care personnel use it in their daily lives and in their work contexts [5].

In light of these, the study depicts the ‘maternal healthcare landscape’ which also sets the stage for the developers of information systems in healthcare, particularly in maternal healthcare in the case setting of Grabouw. The question the paper is attempting to answer is: What are the most essential aspects of the maternal healthcare landscape in Grabouw, a mid-sized town in South Africa not far from the Cape Town metropolis [6], which one should understand as the background for an information systems analysis and design project? Secondly, the study also attempts to further develop an existing method for analysing the ‘healthcare landscape’ around a community [1].

The results of the study can be used by the healthcare service providers, governmental and non-governmental structures, local authorities, researchers and IS developers to understand the maternal landscape in Grabouw; the maternal service care flow (from pregnancy, including labour, to first stages of motherhood). This in turn will be useful in deriving ways to better facilitate maternal healthcare work.

2 Materials and methods

The methodology for depicting information systems landscapes [1] was applied in guiding the data collection and in analysing the data. The methodology is based on the idea of levels of analysis from individual to societal [7] combined with the concept of human activity [8]. The methodology aims at depicting the most essential aspects of the geo-political “canvas” as well as four layers that deal with 1) the organizations, stakeholders and services, 2) structures of management, 3) financial structures, and 4) information flows around the object under study [1]. In this study, the flows of funding were not investigated.

The data was mostly collected from public sources using document analysis. Document analysis is a qualitative research method used “for reviewing or evaluating documents – both printed and electronic (computer-based and Internet-transmitted) material” [9]. Documents such as government documents, web sites and literature were used to gain understanding, draw meaning and give voice to the phenomenon. Experienced health administrators and educationists were consulted to corroborate the data.

3 Results

3.1 Background of Grabouw

Grabouw is a mid-sized town located in the Western Cape Province of South Africa (see Figure 1). It is approximately 65 km south-east of Cape Town along the N2 highway, after the Somerset West town, across the Sir Lowry's Pass. It is situated in the vast Elgin Valley, which stretches between the Hottentots-Holland, Kogelberg and Groenland Mountains, with the valley floor still being substantially hilly [6]. The valley is part of the Overberg highlands that is literally “beyond the mountains” from the Cape Town lowlands. Historically, Overberg was a stronghold of the indigenous Khoikhoi herders [10]. Grabouw’s modern history starts from the establishment of a small trading store in the mid-1800s and the introduction of apple farming in the early 1900s. It is the now the commercial centre of the largest single export fruit producing area in Southern Africa [6], [11]. “The Elgin Valley produces up to 60% of the country’s national apple yield” [6].

The documentation on the population of Grabouw varies. According to the 2011 census Grabouw had 7708 households and a population 30 337 covering a total area of 6.65 km² [11]. Another source states that Grabouw has a population of about 50 000, mostly farmers and farm workers. Approximately 45 000 of these farm workers live in informal settings. Nearly 5000 are migrants coming from Eastern Cape Province and other countries. [12] The main first languages according to the 2011 census were Afrikaans (about 62%), Xhosa (29%) and Sotho (5%) – it is notable that English was the first language for only about 3% of the population. Ethnicity is still recorded in South Africa according to the apartheid-era categories of “race”. In 2011 the main “race” groups were Coloured (about 56%), Black African (39%)

and White (5%). [11] It can be implied that the main ethnic groups are Afrikaans speaking “Coloured”, Xhosa, Sotho and Afrikaners, in addition to several small ethnic groups.

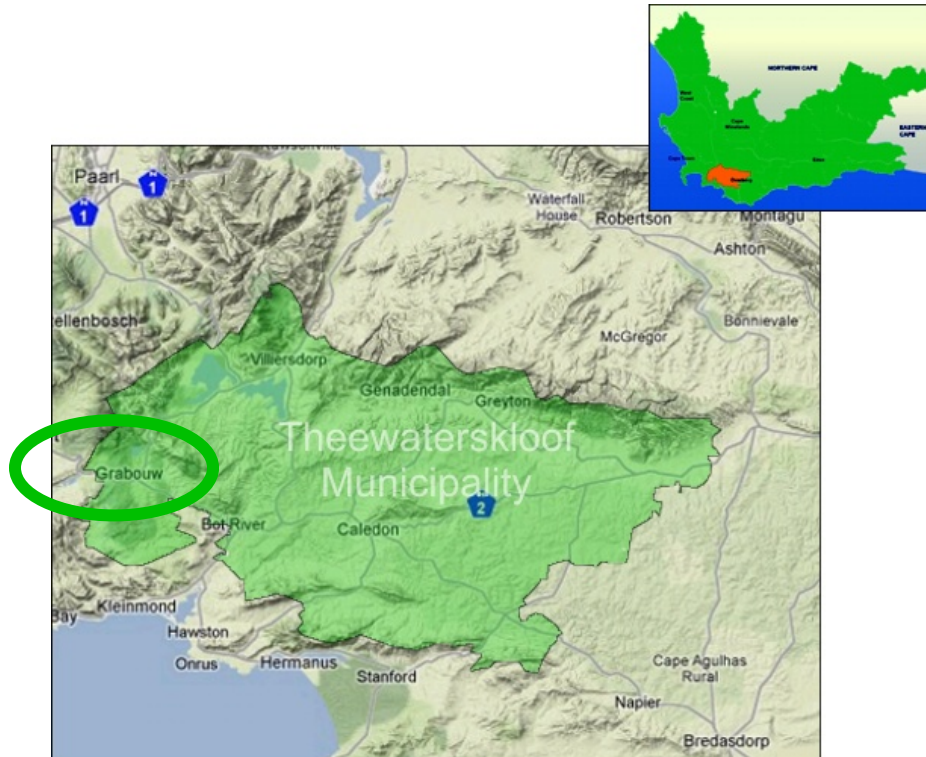


Figure 1. Grabouw in Theewaterskloof municipality in Western Cape. Source: Western Cape Province.

3.2 Geo-Political structure

The landscape methodology starts from identifying geographic areas of political authority with “scopes of power” zooming in from national (or international, if needed) to local, around the community in question, as the “canvas” for further layers of analysis [1]. Figure 1 and Figure 2 depict the geographic areas of authority around Grabouw in the form of maps.



Figure 2. Overberg District (red) within Western Cape (cream) within South Africa (brown). Source: Wikipedia.

Figure 2 shows South Africa's division into 9 provinces, one of which is Western Cape, and further the division of Western Cape into 6 districts, one of which is Overberg. Figure 1 shows the Theewaterskloof Municipality, within which Grabouw town is located, and the municipality's position in the province. A map of Grabouw itself is omitted for space reasons.

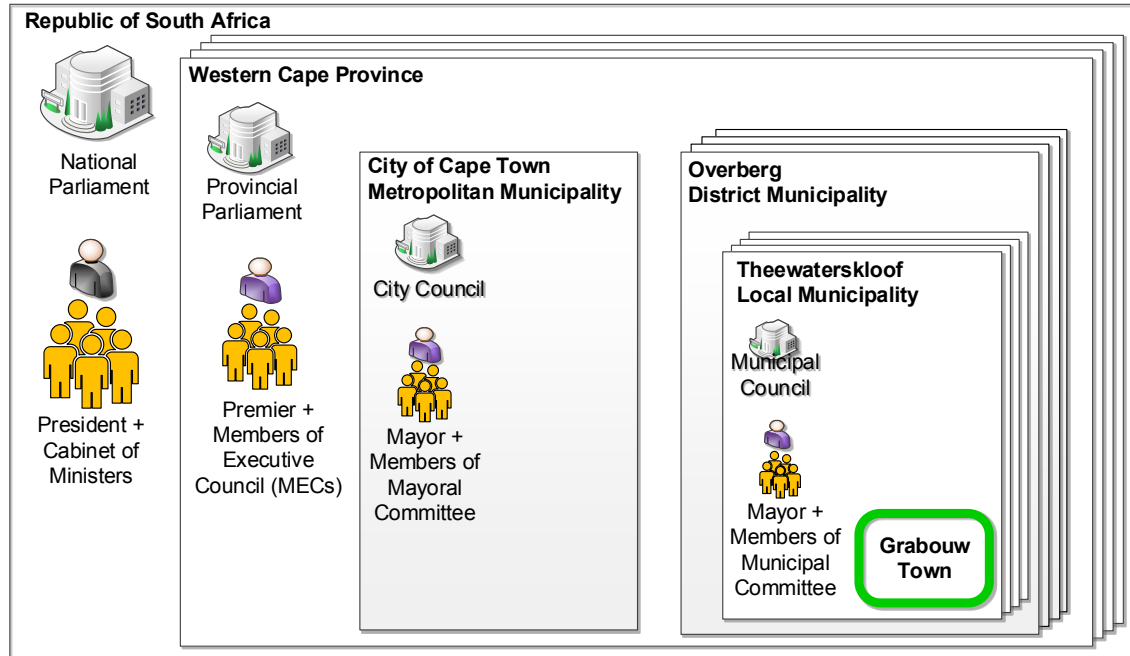


Figure 3. Levels of political authority around Grabouw.

Figure 3 depicts the same information using the notation used in the landscape methodology, and additionally the general structures of authority that belong to layer 2 of the method. There are three levels of political authority in South Africa: national, provincial and municipal. At each level there are elected legislative structures (national parliament, provincial parliament, and municipal council) and executive decision making structures (National Cabinet of ministers headed by the President of the Republic, provincial Executive Committee headed by the Premier, and Municipal Committee headed by Mayor). The democratically elected structures appoint the executive structures. However, there are different types on municipalities. A district municipality (e.g., Overberg) is made up of local municipalities (e.g., Theewaterskloof); municipal elections are held only on the local level, while members of the district councils are appointed proportionally by the local councils. The biggest cities (e.g., Cape Town) are metropolitan municipalities which are at the level of districts but have a directly elected council. [13] Towns (e.g., Grabouw), townships, villages, etc. within municipalities have neither elected nor executive structures of government.

The executive government of a municipality is organized in three ways, that is the plenary, collective and the mayoral systems. In the plenary system (used in Theewaterskloof), authority and managerial powers are vested in the full council, with the mayor as the chairman. In the collective system, authority and managerial powers are vested in an executive committee elected by the council. The members of the executive committee are drawn from all parties in proportion to their representation on the council, and the mayor is chairperson of the executive committee. In the mayoral system (used in City of Cape Town), authority and managerial power are vested in a mayor elected by the council. The mayor may appoint a committee and delegate responsibilities to the members. [13]

3.3 Healthcare organisations and services

The next step in the landscape methodology is to describe the organizational context and stakeholders on top of the canvas of geographic-political structures. The structures and flows of authority are described in a further step. [1] However, in this study the general political authority structures were analysed already

in the canvas, and the healthcare structures and authorities are depicted together now in Figure 4. The National Department of Health (DoH) under the leadership of the Minister of Health has the overall power to regulate and direct healthcare in the country. However, the implementation of healthcare services is the responsibility of the provinces. Municipalities have in general no role in providing healthcare service in their areas, with the exception of metropolitan municipalities. Each district has an allocated number of healthcare facilities and the flows of services from one facility to another are determined by the provincial DoH. According to the Western Cape DoH, there were 44 primary health facilities in the Overberg District in 2013, 17 of which in Theewaterskloof [14].

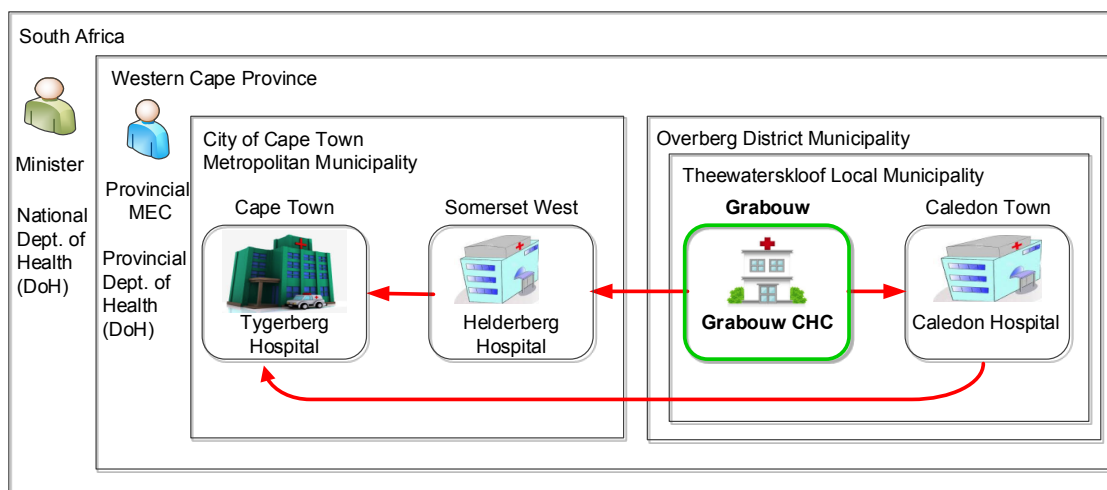


Figure 4. Healthcare authorities and referral structure around Grabouw Community Health Centre.

South African Healthcare system is made up of a large public health sector and a smaller private health sector, which however consumes the bulk of the healthcare expenditure [3]. Healthcare varies from the most basic primary healthcare, offered free by the state, to highly specialised hi-tech health services available in the private sector for those who can afford it [15]. Many health initiatives undertaken by non-governmental or not-for-profit organization supplement the healthcare sector.

Public healthcare. The public healthcare sector caters for the health needs of most South Africans. The public sector is under-resourced and over-used. The care service provision in the public healthcare sector is hampered by many challenges which include lacking or insufficient facilities which leads to overcrowding, healthcare personnel shortages and long waiting times [16] [17]. Provision of services is generally of poor quality particularly in under-resourced areas. The first point of care is located within communities in community clinics and community health centres. If complications are encountered, patients are referred to a secondary level (district) or tertiary level (teaching or specialist) hospital.

In the Grabouw area public healthcare services are provided by the Grabouw Community Health Centre (CHC) also known to locals as the day hospital (Figure 4). Cases requiring specialist care are referred to either the district hospital in Caledon in the same municipality and district as Grabouw but further away from Cape Town, or to the Helderberg Hospital in Somerset West which is closer and bigger but belongs to the Cape Metropolitan Municipality (see the referral arrows in Figure 4). The administrative hierarchy is thus bypassed when needed. The highest level of care for the Grabouw residents is provided by the tertiary level Tygerberg Hospital in Cape Town, associated with the Stellenbosch University.

Private healthcare. The private healthcare sector plays a pivotal role of providing quality healthcare services to South Africans. Over half of the national health expenditure in South Africa is spent in the private healthcare sector, with a GDP of 8.2% towards the country's economy [16]. The rapidly increasing private sector, runs largely on commercial lines, only caters for the elite, predominantly white, middle- and high-income earners who tend to be members of medical schemes (18% of the population), and to foreigners looking for top-quality surgical procedures at reasonably affordable prices [18] [19]. A large number of the country's citizens who cannot afford these services rely on the public healthcare sector. About 512 facilities are dedicated to maternal and child care countrywide [19].

In Grabouw only a small percentage of the population such as the farm owners and their families can afford the private healthcare services. Due to the size, Grabouw does not have a private hospital but there are smaller private health facilities such as general practitioners, dentists and pharmacies (not included in Figure 4). Private maternal healthcare services are also available to those who can afford them.

NGOs. There are several non-governmental (NGO) or not for profit (NPO) organizations that provide healthcare related services in Grabouw [20] (not included in Figure 4). Most of these organizations work with government and department of health facilities to provide home-based healthcare and maternal healthcare services in the area. According to the caregivers most of the work they do around maternal healthcare is advocacy where they provide support and information for people who need it. Elgin Learning Foundation is one of the most active NGOs in the Grabouw area. The work they do ranges from training, home based healthcare, health promotion and TB directly observed treatments (DOTs).

3.4 Maternal healthcare services in South Africa and in Grabouw

Maternal healthcare services provided by healthcare facilities are categorized into antenatal (pre-birth), labour (birth) and postnatal (after birth).

Antenatal (pre-birth) services. According to the Western Cape Government, “pregnant girls and women are referred to maternity services or Midwife Obstetric Units (MOUs) in urban areas and satellite or fixed clinics in the rural areas” [18]. MOUs are units where pregnant women give birth and these units are run by midwives in the community for primary healthcare patients. Expectant mothers are advised to book their first visit to the clinic before 20 weeks or immediately hereafter. [18]

When the expectant mother comes for the first visit (referred to as the booking visit), a full assessment and counselling is given. She will be weighed, her blood pressure taken and urine tested. The pregnancy and the mother's health are closely monitored through regular follow-up visits. If there are no complications, she is advised to return for her first follow-up visit after two weeks for the results of the tests taken during the booking visit. After this, she is expected to return to the clinic every six weeks until up to 28 weeks, then at 34 weeks, thereafter as indicated by the clinic/MOU staff. [18]

The Western Cape Government further states that the expectant mothers should be screened for possible risks to their health and the health of the foetus. Both teenage girls and women over 35 years old who are pregnant are regarded as risk cases. This means that they are more likely to have complications during pregnancy and birth. Pregnant women may also be seen to be in risk if they have elevated blood pressure, a history of genetic disorders, multiple pregnancies and if they have had previous surgery such as a caesarean section. Mothers who are diagnosed as risk cases are referred up the line to outpatient antenatal clinics at the secondary or tertiary level hospitals, where further investigations and screening tests are carried out. Mothers with risk pregnancies are advised to attend outpatient antenatal clinics as often as necessary. Low-risk pregnancies are managed at the MOUs. Risk pregnancies are managed at outpatient clinics at urban and rural regional hospitals and tertiary hospitals. [18]

Labour (birth) services. Mothers can deliver at fixed clinics or MOUs, with the assistance of midwives in the community health centres for primary healthcare patients. If complications arise during birth then they are transferred to a hospital a level up. Mothers who are HIV positive can join the Prevention of Mother to Child Transmission (PMTCP) service. [18]

The Western Cape Government website (2013) states that expectant mothers are encouraged to bring a birthing partner (husband/friend/relative), known in the service as a “doula”, to assist with the birthing process. It has been found that mothers accompanied by a doula need less pain medication because they feel supported. [18]

Postnatal (after birth) services. Postnatal services become available after the mother and her newborn have been discharged from the MOU or clinic. This usually happens six hours after the birth if both mother and baby are in good health. Following the birth, the infant's umbilical cord is checked at follow-up visits to the clinic every day for three days to make sure it does not become infected. Clinical personnel assist mothers with breastfeeding or other feeding options to ensure that the baby is getting enough milk. If the baby has a low birth weight, mothers are trained in Kangaroo Mother Care (KMC). [18]

The mother's health is regarded to be as important as that of the newborn. Mothers are examined at the clinic on follow-up visits to check that the uterus (womb) has returned to its original position. The clinic personnel also offer mothers counselling on available contraception /family planning options. Some

women struggle with the demands of being new mothers and clinic staff are trained to assess them to see if they are suffering from the “baby blues” – Post Natal Depression or Post Natal Psychosis. If there is a problem, the mother may be counselled, given medication or referred to secondary or tertiary hospitals for further assessment or treatment. [18]

Maternal care service in Grabouw. Maternal health care services are offered at the primary, secondary and tertiary level depending on the required level of care (Figure 5). Grabouw has accessible community clinics for maternal care where pregnant woman are reviewed during pregnancy from the first visit every six weeks until 36 weeks gestation. The community clinics have basic antenatal care services (BANC) which are 8 hour services for 5 days a week. Some of the BANC services are offered at satellite or mobile clinics set within communities for accessibility of the services. The community health centre offers the satellite services one day a week where new pregnant women are booked and follow up care is done up to 36 weeks.

Furthermore, the Grabouw Community Health centre (CHC) has a 24-hour service running for pregnant women who need emergency care and for those in labour (Figure 5). The antenatal clinic at the CHC attends to pregnant women living within the area of the CHC from when they come to the clinic for the first time until after delivery. Likewise the pregnant women from the BANC and the satellite/mobile clinics receive continuation of care after the 36 weeks gestation in the CHC where there is a MOU. The care is provided from 36 weeks through labour, birth, the postnatal periods and follow-ups until 10 days during the motherhood.

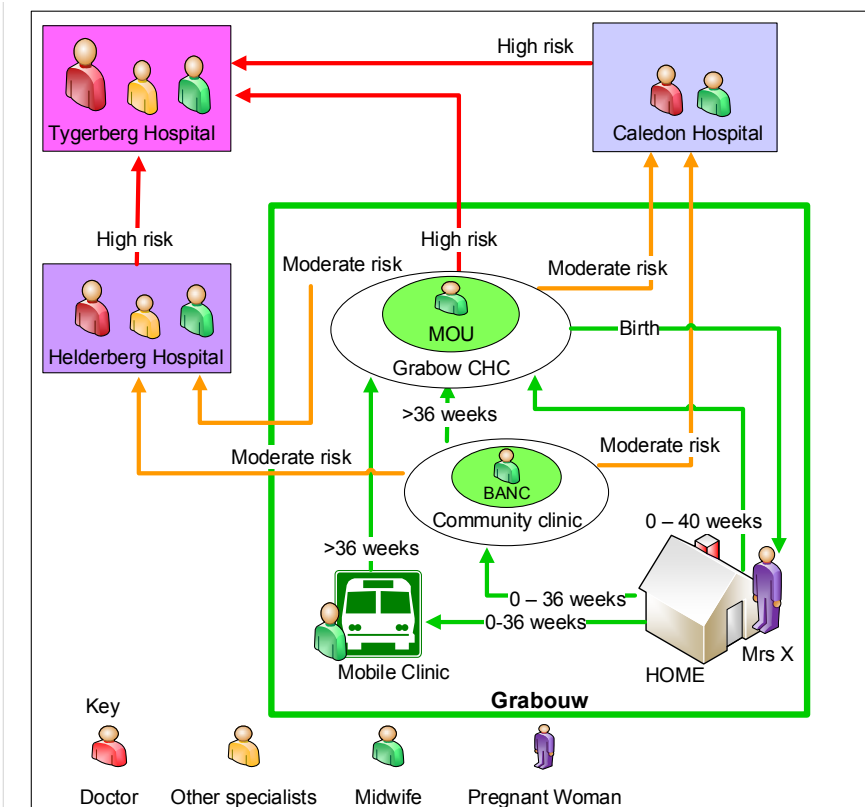


Figure 5. The main maternal healthcare service flows in and around Grabouw.

Caregivers in the home-based services advise the ladies that are still in the early months of the pregnancy to visit a clinic. This is done so that the expectant mothers may be examined to ensure healthy pregnancy from initial stages. Some people in the Grabouw area live close to the Grabouw CHC and therefore prefer to go the hospital as it caters for early pregnancy as well as other stages until the child is born. Expectant mothers who are considered potential risk cases can be referred from the mobile clinics to Grabouw CHC as well as to Caledon or Helderberg hospitals (Figure 5). Helderberg Hospital seems to be a preferred choice among the people of Grabouw as it is closer with a less limited numbers of beds, but sometimes

expectant mothers are referred to the Caledon Hospital. The CHC likewise refers moderate risk cases to Caledon or Helderberg Hospitals, but high risk cases directly to Tygerberg Hospital (Figure 5).

3.5 Flow of maternal healthcare information

The final step in the landscape methodology deals with analysing the flows of information [1]. In this study the analysis was done in a cursory way only, based on how it was presented in official guidelines [18].

First time visitors to a maternal health facility are asked to complete a form, based on which a folder known as the Maternal Case Record will be opened afterwards. The expectant mothers are required to have their Identity Document (ID) book (a passport in the case of foreigners). Patient history and also the medication they are taking are recorded. If the expectant mothers were previously registered at another facility, a clinic or hospital card is required. After the tests and assessments have been carried out the results are recorded. The expectant mothers are required to have their Maternal Case Records with them for every visit thereafter until they give birth. The health facility gives all mothers a Road to Health Chart (RTHC) when the baby is born. This card is kept at home and must be given to the sister on follow-up visits to the clinic. The card is an ongoing record of the child's health from birth to five years of age.

4 Discussion

The results show that it is vital to understand the 'healthcare landscape' in order to contextualize the findings. South Africa has many structures, such as the geo-political and healthcare authority structures that sometimes overlap and therefore the need to create awareness of the landscape. Various services are offered at different levels of care in the Western Cape. According to the findings, although a structure is set and referral protocols need to be followed, patient preference for services takes precedence during referral. The community clinics and the community health centers are both within the reach of the clients but the community prefers to visit centers where they receive more comprehensive services. The mobile and satellite services are offered by the community health centers in order to meet the need for accessibility of maternal health services by skilled birth attendants. However the services are limited to low risk patients and can only be offered until up to 36 weeks gestation.

However the clients come for services even after 36 weeks gestation, during labour and delivery. The fact that they cannot be turned away for these services means that the services are offered even with minimum preparedness by the skilled birth attendants. These services being one day a week are accessed by as many clients as possible. The community health centre which offers 24 hour services makes it possible for women in labour and in emergency situations to access the services whenever necessary. The categories of patients managed in the community health centre are the low risk patients with moderate risk patients being referred to the secondary level of care in hospitals. All high risk patients are managed in the tertiary hospital where the specialists and specialized equipment is available.

This study was conducted to set the stage for information systems analysis and design for maternal care, focusing on the community level. The results show that it is feasible to conduct a study on the "landscape" using publicly available information, mainly government documents, at least in South Africa. Wikipedia was often the best starting point for searching for the original sources of information. However, guidance by experienced health administrators and educationists significantly speeded up the enquiry.

The purpose of a landscape study is to provide a broader picture *around* the community and healthcare service in question. Participatory, collaborative methods are then needed to proceed *into* the concrete situation in the community and healthcare service in question.

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References

- [1] Korpela, M., Luukkonen, I., de la Harpe, R. 2008. Depicting the Landscape around Information Flows: Methodological Propositions. Proceedings of SIG GlobDev's First Annual Workshop. Available from: <http://www.globdev.org/files/29-Paper-Korpela-Depicting%20the%20landscape-Revised.pdf>
- [2] Bamford, L. 2012. Maternal, newborn and child health: service delivery. SAHR 2013/13
- [3] South African Info. 2010. Healthcare in South Africa. Available from: <http://www.safrika.info/about/health/health.htm>
- [4] Van Zyl, I., de la Harpe, R. 2013. Prioritising University-Community Engagement in North-South Research partnerships. SANORD International Symposium 2012. Cape Town.
- [5] Palmén, M. 2013. Midwives, Families and Everyday Health Information and ICT Interactions. Dissertations in Social Sciences and Business Studies No 71
- [6] The Cape Meandor. 2014. The Cape Meandor - Botrier, Caledon, the Elgin Valley. Available from: www.thecapecountrymeandor.co.za/Mobile
- [7] Korpela, M., Mursu, A., Soriyan, A. 2001. Two times four integrative levels of analysis: A framework. In: Russo, N.L., Fitzgerald, B., DeGross, J.I. (eds) *Realigning Research and Practice in Information Systems Development: The Social and Organizational Perspective*, pp. 367-377. Boston: Kluwer Academic.
- [8] Luukkonen, I., Toivanen, M., Mursu, A., Saranto, K., Korpela, M. 2013. Researching an Activity-Driven Approach to Information Systems Development. In: Cruz-Cunha, M.M., Miranda, I.M., Gonçalves, P. (eds) *Handbook of Research on ICTs and Management Systems for Improving Efficiency in Healthcare and Social Care*, vol 1, pp. 431-450. Hershey (PA): IGI Global.
- [9] Bowen, G.A. 2009. Document analysis as a qualitative research method. *Qualitative Research Journal* 2(9).
- [10] Schoeman, K. 2007. *Early slavery at the Cape of Good Hope, 1652-1717*. Pretoria: Protea Book House.
- [11] Frith, A. Census 2011 - Main Place "Grabouw". [Online]. Available from: www.Census2011.adrianfrith.com/place/171009
- [12] Western Cape Government. 2010. French Government Donates R13 Billion for Grabouw Community Health Centre Upgrade. [Online]. Available from: <http://www.westerncape.gov.za/news/french-government-donates-r13-billion-grabouw-community-health-centre-upgrade>
- [13] Western Cape Government. 2006. Handbook for Municipal Councillors. [Online]. Available from: http://www.westerncape.gov.za/text/2006/4/handbook_for_municipal_councillors.pdfhttp://www.westerncape.gov.za/text/2006/4/handbook_for_municipal_councillors.pdf
- [14] National Department of Health (DoH). 2013. Healthcare facilities in Overberg. [Online]. Available from: <http://www.westerncape.gov.za/facility/grabouw-community-health-clinic>
- [15] Mediaclub South Africa. 2009. Healthcare in South Africa. [Online]. Available: http://www.medioclubsouthafrica.com/index.php?option=com_content&view=article&id=102:healthcare&catid=34:developmentbg
- [16] Cullinan, K. 2006. Health services in South Africa: A basic Introduction. Available from: <http://www.health-e.org.za/uploaded/cb1f388f3b351708d915c12cfb4fc3cf.pdf>
- [17] Van Zyl, I., Pennanen, M. 2013. Service design as an approach for envisioning e-health solutions: Mapping the context of development in Grabouw, Western Cape.
- [18] Western Western Cape Government. 2013. Maternal Healthcare Services. [Online]. Available from: <http://www.westerncape.gov.za/dept/health/services/1085/17813>
- [19] South African Professional Practitioners Forum (SAPPF). 2013.
- [20] Western Cape Government. 2012. Department of Health Budget Speech 2012 [Online]. Available: <http://www.westerncape.gov.za/speech/departement-health-budget-speech-2012>

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Building locally relevant models for universal health coverage and its implications for health information systems: some reflections from India

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The global health agenda is placing Universal Health Coverage (UHC) as a foundational element of future health reforms. However, a missing link in these discussions is the implications that UHC will have on the supporting Health Information Systems, and how can countries get ready with effective HIS. Also, as calls for country specific research on UHC gains prominence, it is important HIS related research gets integrated in this agenda. This paper speaks to this agenda, and describes an ongoing pilot study from the state of Punjab in India with a focus on the implications of UHC models on HIS. Five key implications on HIS are identified: Expanding basket of services; Population basing of services; Ensuring continuity of care; Resource allocation choices; Monitoring financial protection and costs of care

Keywords: UHC, HIS, India

1 Introduction

As the Millennium Development Goals (MDG's) [3] draws to a close, many believe it is still remains unfinished business especially related to issues of rights and equity. Efforts are ongoing to articulate or redefine a global agenda to which nations can anchor further public health strengthening efforts. The post MDGs agenda is rapidly moving towards Universal Health Coverage (UHC) as the principal step for most Low and Middle Income countries (LMICs) [2, 3]. This is reflected in the Dr. Margaret Chan, DG WHO's concluding address to the 2012 World Health Assembly, where she stated that "Universal Health Coverage is the single most powerful concept that public health has to offer."

The 1948 constitution of the World Health Organization (WHO) had declared health as a fundamental human right, and this was again reiterated in the "Health for All" agenda set out in the Alma-Ata declaration in 1978 [6]. The key development in the contemporary UHC discourse is the emphasis on access to effective health services without incurring financial hardships. This development comes figures, which indicate that more than 150 million people are facing catastrophic economic expenditure and impoverishment from paying out of pocket for necessary health services.

The UHC agenda can be traced to the resolution of the 2005 World Health Assembly, which called on governments to "develop their health systems, so that all people have access to services and do not suffer financial hardship paying for them." Another important milestone, was in December 2012, when the United Nations General Assembly called on governments to "urgently and significantly scale-up efforts to accelerate the transition towards universal access to affordable and quality healthcare services." Today, many LMICs are implementing programs that aim to advance the transition to UHC, and also conducting research to support this process.

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It has been recognized by global and national agencies that there are many paths towards UHC fulfilling the aims of improving health outcomes, including reducing the financial risks associated with ill health, and increasing health equity. Countries will have different health priorities, different trajectories of health systems development, different organizational and financial arrangements in place, and varying capacities to achieve the aims. In countries like India, this diversity will also be seen at the levels of states (provinces) and districts. Recognizing this diversity, the 2013 World Health Assembly has strongly argued for countries to carry out research through specific case studies to develop appropriate models and approaches to achieve it. Similarly, the World Bank launched the Universal Health Coverage Studies Series (UNICO Study Series) to develop case studies that analyze different issues related to the challenges of UHC policy implementation.

However, in these various discussions, case studies, and policy papers on UHC, a missing dimension remains the implications on the supporting Health Information Systems (HIS) these different UHC models involve. Traditionally, the National HIS in countries have focused on aggregate statistics, and that too largely of reproductive and child health services and from public providers. Even this data has suffered from challenges related to data quality and reliability as well as fragmentation, insufficient use of information and weak supporting human capacities [1]. UHC models will require supporting HIS that are significantly different from existing ones, with respect to recording a much larger package of service delivery, and supporting continuity of clinical care across public and private providers and across different levels of care, aggregating this information from multiple sources, and incorporating financial information, to support informational needs of multiple financial providers, including the state, private and community-based players.

After much deliberations, India has decided on a broad framework of how it intends to progress towards UHC which is expressed in the 12th Five Year Plan document, and by subsequent guidelines issued by the central ministry to the state departments. This framework broadly proposes an architecture where primary health care and a considerable part of secondary health care are provided by a strengthened public district health system. This is supplemented by purchase of health care using insurance mechanisms or contracting arrangements from the private sector- especially for a part of secondary care needs and much of tertiary care needs. The actual mix of public and private, and the content of the essential health package in primary, secondary and tertiary care would be based upon state specific situations.

Given this unexplored domain of UHC implications on HIS, this paper focuses on the following two research questions:

- a. Within the broad framework outlined above, how have specific states planned to progress towards UHC and what are the challenges they are facing?
- b. What implications does this model have on the supporting HIS and how have they been approaching this challenge?

In the next section, we first discuss the broad conceptual framework being proposed for UHC by the World Health Report 2010 [8] and the implications this has for measurement. Following this, we discuss how one Indian state is trying to develop a locally relevant model for UHC and the implications this has for HIS design. Finally, we discuss some challenges and also approaches that need to be engaged with in developing a robust HIS to achieve UHC goals.

2 Materials and methods

Understanding the conceptual framework of Measuring Progress towards UHC.

Previous three World Health Reports (WHR) were dedicated to the UHC and a renewal of the Primary Health Care (PHC) system. While the WHR of 2008 emphasized the need to renew PHC services as a vehicle to achieve UHC, the 2010 report outlined financial strategies to achieve financial protection to citizens by reducing out of pocket expenditures. The report presented a conceptual framework to measure progress towards UHC across three dimensions. The first captures the range of services covered (service

coverage); the second measures the proportion of total costs covered through insurance or other risk pooling mechanisms (financial coverage); The third dimension measures the proportion of the population covered (population coverage), and reflects distribution of coverage across various population sub-groups. The figure below schematically depicts this model.

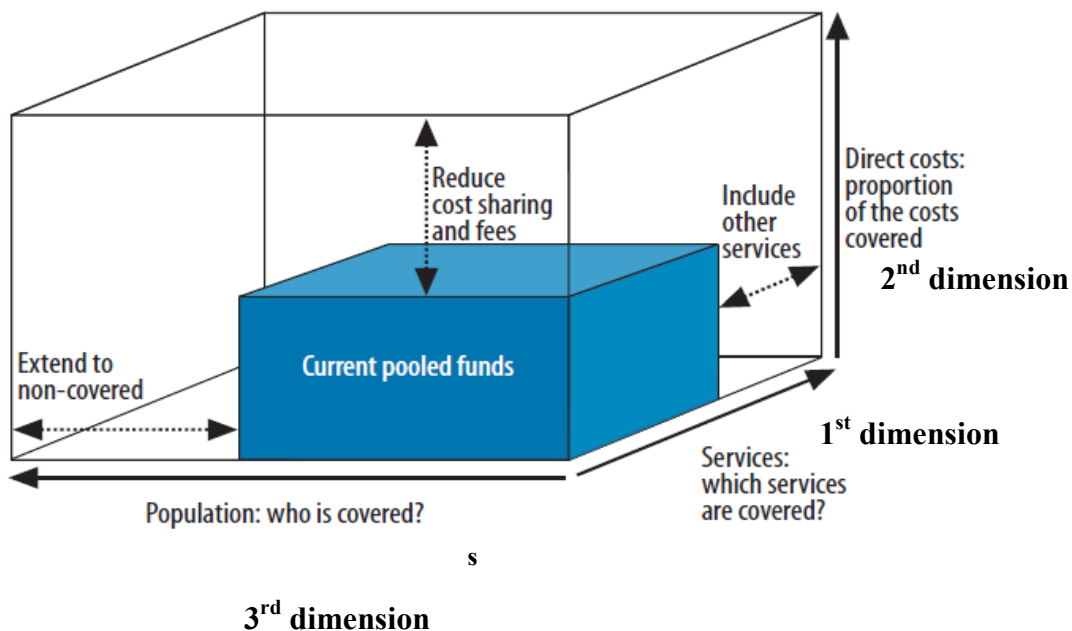
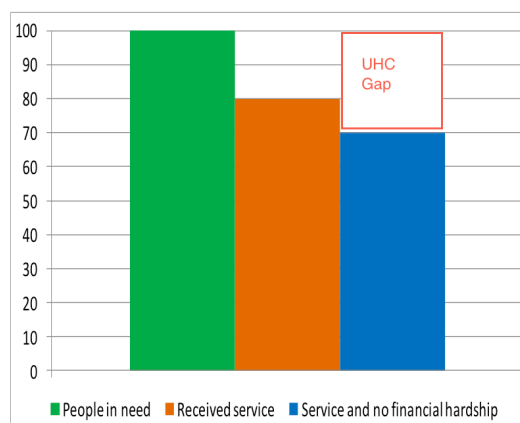


Figure 1. Three dimensions to consider when moving towards universal coverage (The World Health Report 2010)

Though visually attractive and conceptually clear this “UHC cube” presents considerable problems in measurement- especially in mixed systems where free care by public providers and insurance mechanisms are both forms of achieving financial protection and access. One problem is that both coverage and financial protection could vary widely depending on which service we are studying. For example, immunization services would have complete financial protection with complete population coverage, whereas less than 10% of diabetics may be able to access free care. In financial protection- the height of the cube- whereas out of pocket expenditure is easy to ascertain, the public expenditure on a specific service is not. In coverage- the breadth of the cube- the difference between nominal coverage, effective coverage and utilization poses problems for measurement. Thus the entire population is covered for immunization, but only 60% of children may have actually received it. Or the entire population may be covered by accident insurance, but only one thirds of trauma patients may have accessed free care. Conversely better utilization is not necessarily more effective coverage- as for example a situation where 50% of pregnant women utilize C-section services.

There is therefore an recognition that a simpler way to express measurement of progress could be to measure the proportion of persons in need of health care who are able to access the requisite services which are effective and do so without facing financial hardship. This could be expressed as a simple bar chart- and by aggregating across bar charts made for each service we are interested in, to arrive at a more action-oriented measurement of progress.



Simple sample surveys conducted with a given periodicity could easily capture the above information at the level of the nation or state. But HIS should also be able to generate this information from data available in the form of routine recording of service delivery, from the use of information required to enhance patient care, and to support monitoring and financial allocations. Whereas at the policy level the priority is to measure overall progress on the three axis- for the service provider and programme manager, the priorities are keeping track of services delivered, ensuring continuity of care, and better financial allocations and supportive supervision. The HIS architecture to support UHC, needs all of this, and more, in place.

Experimenting with appropriate UHC models: Reflections from an Indian state

One of the states that has begun working towards UHC is the state of Punjab, located in India's northern region. To understand the challenges better it has identified a median performing district called Nawashahar and developed a district plan that could provide direction to this effort. This pilot district programme is led by its district health society which has the head of the district administration in the chair and the chief district health officer as its member secretary. Providing technical assistance are two public health institutions (school of public health, PGIMER, Chandigarh, National Health Systems Resource Center), and two health informatics agencies- the not for profit Health Information Systems Project,(HISP) India, and Reliance-Jio. The state leadership and its state health resource center are also fully involved.

The primary care in the state is largely provided by a network of public primary care facilities- health sub-centers, primary health centers, supported at the community level by community health workers called ASHAs and village health committees. It is networked with and provided with referrals support above with the district and sub-district hospitals. As of today, this network provides a population based coverage for care in pregnancy and child immunization. For other morbidities, there is no population based care, but those who need care can approach the public or private health care facilities. At the peripheral public facility most care available for non RCH conditions is basic and often of a symptomatic nature, but at the district and sub-district hospital the full range of primary and a substantial part of secondary care is available. Private insurance and publicly financed insurance covers a minority of the population and this provides cover for some types of hospitalization.

Given this context, progress towards UHC meant five reform measures. These are listed below:

The first and foremost element of moving towards UHC meant expanding the basket of services that are available at the primary care level to include the most important causes of morbidity in the area. This would mean a substantial addition of care directed at common non-communicable diseases and mental health into the primary care agenda. Diseases that were prioritized in this district were hypertension, diabetes, asthma and chronic respiratory disease, epilepsy, depression, substance abuse, and oral, cervical and breast cancers and blindness. This is in addition to the traditional concerns of reproductive and child health, and the two main chronic communicable diseases of this area- tuberculosis and HIV.

The second element of this approach to UHC, would imply that care would not be merely responsive to care seekers – but a population based preventive, promotive and curative effort which measures success by a reduction of rates of these NCDs and the costs of care and complications in these patients. This means the need to know population rates for these diseases and population rates for utilizations of services and service outcomes.

The third element of this approach is the continuity of care. Most of these diseases require a specialist consultation and secondary care diagnostics. Primary care is more as early detection, ensuring continuity in medication and follow up with counseling and periodic testing and support. The primary, secondary and tertiary provider needs to be electronically and institutionally bridged so that they act as a single provider entity- which could be challenging if some providers are private and insurance paid, and others are public and salaried. Continuity of care also needs a commonly agreed upon standard treatment guidelines and standard operating procedures.

The fourth element of this approach is financial allocation made within the district which is responsive to caseloads and the actual package of care provided. This would include contracting in arrangements as well as to public facilities handling very widely different case- loads.

And finally there is the challenge of ensuring that care provided is really without out of pocket expenditure on drugs and that there are no financial or social barriers leading to exclusion or under-utilization by any section of the population. Needless to say we also need to add, that free care by government providers or purchase through insurance is so governed and managed that there is value for money and that public expenditure is not wasteful and inefficiently organized.

3 Results

Implications of UHC on HIS

Based on this understanding of the approach to UHC, an exercise was undertaken to design the design features and technical specifications of a health information systems that would be able to support this. In each situation we have to build upon what is current practice and what are the capacities available on the ground.

1. Expanding basket of services: Implications for HIS:

The HIS would need to store information about services provided for a much larger range of services. Currently information on care in pregnancy and immunization and contraceptive services are captured in a set of registers manually, and these are then taken to the block headquarters where they are fed into computers which then prints out the aggregate data and the follow up on services needed. In addition some key daily activities of the health worker are provided on mobiles to the state level as a method of monitoring their work. The aggregate data is also fed into a web-portal for state and national level analysis. The process of capturing the information on paper, entering it into computers on a distant site, and then getting the analysed actionable information a week or two later is inefficient and error prone. Clearly if the data recorded in an electronic format, leads to generation of locally actionable information then and there, efficiency and reliability is better. Also the time spent on data management is almost one fourth to one fifth the total work time available.

What is a desirable when the system is providing only this small basket of services, it becomes mandatory when the basket of services expands. The system would need to invest in digital devices that a field level primary care provider can use to record information on services delivered- and this would enable follow up of the service user at the appropriate time as well as take over the compilation of records for reporting purposes. It would also need to invest in more HIS human resources at the primary center level- so that the collection of information from so many individual clinical care giving encounters by so many care providers is properly stored and retrieved.

2. The Need for Population Basing of Services: Implications for HIS:

Going beyond the recording of services provided, the primary care facility has to track what proportion of the population is covered, and identify those who are unable to utilize these services. It also requires an

understanding of the disease profile of the population. In terms of HIS, it means a good coordination with the civil registration system of births- for ensuring the full population is identified and deaths – for a reliable and readily available measure of illness. It requires information on what percentage of the population, disaggregated by equity concerns have been screened for specific diseases and have utilized services or have experience illnesses that were preventable. Here the challenge is to relate the clinical encounters and records of service provided to the population data base and generate the necessary analytics at the decentralized level.

Another related issue- not so much a problem in developed nation contexts, but of great importance when we look at the equity imperative is to be able to identify exclusions.

3. Ensuring Continuity of Care: Implications for HIS

Ideally this is solved if we have a standardized electronic health record, with rules in place for access, privacy, confidentiality in place. The case record of the patient seen by a specialist is available to the primary provider for follow up, and to the specialist during the subsequent check-up with exchange of information and instructions between providers. Many HIS systems in the OECD countries are built around this. Further, if all EHRs are on a common data warehouse, there can be disease specific registries that would provide support to research too.

Technical capacity for doing this is readily available. Indeed much of the support of EHR based information systems even for the USA is done from Indian shores, and often by Indian companies. What is not in place is institutional capacity. The district would have to incrementally move forward by first introducing hospital information systems, then increasing the level of completion of EHRs in these hospitals and then sharing at least key portions of this with primary providers and arranging for information transfer to accompany referrals in either direction. The primary care provider would also be unable to start with EHRs and various interim name based arrangements may have to be experimented with. Also the rules and obligations for such necessary information transfers would need to be put in place.

Where insurance based purchasing is in operation, mandate to provide population based aggregate data to district and sub-district public health managers, and primary care follow up data to primary providers would need to be mandated. This is easier said than done. To the corporate provider the profit is in the tertiary care hospital- which acts as the hub, and primary care – the spokes- becomes as much a mechanism to scout for tertiary care opportunities as to provide primary care. The information priorities of such a model are very different from a model where the primary provider is the hub, acting as a gatekeeper against inessential tertiary care and putting the emphasis on prevention and local follow up, rather than on repeated visits to the specialists and costly diagnostics. When a HIS has to ensure continuity of care between a public primary care provider and an insurance paid tertiary care provider, these problems could become the limiting factors to any model ever going through.

4. Resource Allocation- the implications for HIS.

As the number of services increases normative fund allocation to facilities break down as patterns of utilization begin to vary widely across facilities, and across regions. Management of resource allocation-whether financial, human, or drugs and supplies would need reliable systems of information gathering, validation and use. Insurance companies do make payments based on information gathered electronically- but the same logic does not apply to primary care or for provision of critical management inputs in public systems. Most national HIS have some level of integration with financial management, logistic and human resource management systems- but clearly the demands on these in a move towards UHC would be much more.

5. Monitoring Financial Protection and Costs of Care: Implications for HIS:

A new challenge is the measurement of both financial protection and the costs of care. . There is now an international consensus on key indices of financial protection- the catastrophic head count, the mean positive overshoot due to catastrophic payments and the incidence of impoverishment due to health care. Though the computation of these indices will continue to depend on periodic well-constructed surveys, the role of monitoring out of pocket expenditure gains importance, given the primary focus on financial risk protection. Details that will need to be compiled will include costs and break up of costs into components like consultation fees, medication, diagnostics, in-patient services, therapeutic procedures, travel etc.

A further challenge is to measure the costs of care to the provider and system which is important to ensure value for money in a context where there is a multiplicity of providers including the government, private insurance companies, community based organizations and others. Some of these latter indicators

will necessarily come from multiple sources such as departments of finance, statistics, health and home. To generate these indicators the NHIS will need to be able to speak to these different databases and access data.

4 Discussion

Implementation Challenges:

Having mapped the extensive needs of information, even for such a modest move towards UHC as is planned in the district UHC pilots of Punjab state we briefly touch upon three implementation challenges for such a transition.

The first and foremost challenge is the need for integration and interoperability across multiple systems. It is unlikely and undesirable for all this information to be gathered and maintained on a single application. Multiple systems are inevitable and unless these systems can talk to each other, there would be no possibility for getting the information required.

Ensuring interoperability would require forward movement at three levels- firstly in defining the data definitions, and secondly in defining the data and meta-data standards, and finally putting in place the necessary rules and obligations at the institutional level. Considerable work has happened in defining these in the Indian context, and a high powered committee has prepared and widely disseminated a set of draft standards. But curiously like in many other aspects of UHC there is a last mile in terms of notifying the standards and putting a mechanism to monitor implementation that is not done.

The second big challenge is in implementation is capacity building. The staff, systems and the skills needed for such an expansion in HIS require higher investments and well planned skill development programmes.

The third big challenge relates to governance and institutional processes required for appropriate technology choices and innovation. The current mechanisms of procurement and contracting of IT developers, involves selection of single agency through a competitive bidding process, who can then provide the solutions and assist the operationalization through a single all time contract. What we probably need is a multiple innovators working in parallel in developing prototypes in a collegial atmosphere, with a long time commitment to support requirements that would be dynamic and evolving. Technology choice currently favors a design where a strong central agency is able to see all, and record and monitor every single health encounter on a single central platform. What is more likely to sustain is a system that empowers local providers and mid-level managers in an atmosphere of trust, with information needs of higher levels of governance being obtained as a collateral to the local process.

Conclusions: building global and local research agendas on HIS to support UHC

Traditionally, HIS in countries have focused on aggregate systems for the generation of statistics. For UHC to be actively supported by effective HIS, a radically new type of HIS would need to be developed which spans the three dimensions of UHC, and would also need models of governance which are necessarily multi-sectorial and with stronger frameworks of regulation. WHO and other global agencies have identified the need for research to develop models of UHC which are both country specific and also represent global priorities. This research agenda needs to be further expanded to also include research into the development of appropriate supporting HIS. Such research will necessarily need to be based on inter and intra-country models involving multi-stakeholder participation to understand these complex and uncharted territories. Further, the research will necessarily need to be long term and multi-disciplinary involving health policy, information systems, public health, anthropology, implementation and various others.

References

- [1]. Braa J & Sahay S. (2012). Integrated Health Information Architecture: Power to the users. Design, Development and Use. Matrix Publishers. New Delhi, India.
- [2]. HMN (2011). Country Health Information Systems – a review of current situation and trends. Health Metrics Network. World Health Organization.
- [3]. MDG Report (2013). The Millennium Development Goals Report. United Nations.
- [4]. UN 2012. Addressing inequalities: The heart of the post-2015 agenda and the future we want for all. United Nations System Task Team on the Post-2015 Development Agenda.
- [5]. http://www.un.org/millenniumgoals/pdf/Think%20Pieces/10_inequalities.pdf.
- [6]. WHO (1978). The Alma Ata Declaration. World Health Organization. http://www.who.int/publications/almaata_declaration_en.pdf
- [7]. WHR (2008). The World Health Report 2008 - Primary Health Care, Now More Than Ever. World Health Organization.
- [8]. WHR (2010). The World Health Report. Health Systems Financing and the Path to Universal Coverage. World Health Organization.
- [9]. WHR (2013). The World Health Report 2013 - Research for Universal Health Coverage. World Health Organization.
- [10]. 66th WHA (2013). Sixty-sixth World Health Assembly, Universal Health Coverage. World Health Organization. Provisional agenda item 17.3. 22 March 2013.

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