

Interoperability, Integration and Standardization of e-Health Initiatives in Malawi: Current Efforts and Prospects

Shawo MWAKILAMA¹, Marlen CHAWANI², Maganizo MONAWE³, Gibson KAPOKOSA³, Oliver GADABU¹

¹*Baobab Health Trust, Barron Avenue, Area 3/13, P.O. Box 31979, Lilongwe, Malawi
Cell: +265 995 851 829, Tel: + 265 1 750 604*

Email: smwakilama@yahoo.co.uk / shawo.mwakilama@baobabhealth.org

²*PhD Candidate, Department of Informatics, University of Oslo, Norway*

³*Centre for Monitoring & Evaluation Division, and ICT Department, Ministry of Health, Malawi*

Abstract

Since its inception in Malawi, e-health continues to offer new opportunities for improving health-care delivery in the country. In places where implementations are done right, it enables proper and easy management of pharmaceuticals and lab samples together with results, provides clinical decision support and better patient management, and facilitates easy generation of reports for facility managers and policy makers. However, with the presence of many different e-health solutions and implementers in the country, for the health-care delivery system to be streamlined and benefit fully from e-health there is need for the electronic systems to meet certain standards that would enable their interoperability and integration with other systems at present and in the future. This paper, therefore, is focusing on current efforts on, and future prospects for achieving e-health system's interoperability and integration in Malawi. It is with an understanding of the current state that appropriate recommendations can be made for how the issues in question can be addressed today, rather than wait until in the future when it will potentially be very difficult and costly to resolve.

Keywords

e-Health, Interoperability, Integration, Standards, Electronic Medical Record Systems, mHealth.

1. Introduction

This paper seeks to review current efforts on interoperability, integration and standardization of e-Health implementations in Malawi. It also examines future prospects for realization of the same, and makes recommendations that when followed the three key aspects in question can be attained. The paper argues that Malawi has to make all e-Health solutions in the country inter-operable, integrated and standardized sooner than later, and that it is only through a clear and concrete road-map in place that this can be achieved. If this is delayed, it will be a costly and difficult undertaking when done during a period when the country will have many e-Health systems that are mature and deployed in many health facilities across the country.

As Kanjo et. al. (2008) argues, fragmented information systems do not provide conducive environment for optimum utilization of information in rationalizing the decisions regarding planning and management of health services. Again, with existence of a silos of e-Health systems that do not communicate, whether within or across health facilities, continuum of patient care is greatly affected. In this case, people rely on paper to transfer records from one system to another, which in itself is also additional work for the health-workers.

1.1 Background

e-Health is becoming a key component of the agenda in the health sector, particularly in resource constrained settings, such as the Sub-Saharan Africa. The primary purpose for having e-health systems is to help improve health care in terms of efficiency and effectiveness (WHO; and WITSA, 2006), and provide strategic data. e-Health, for instance, facilitates easy management of big cohorts of patients (e.g. in ART programs), management of pharmaceuticals and supplies, and ordering of lab tests and sending of results to clinicians. Doing all this in a manual set-up is very cumbersome and time consuming. In Malawi, e-health emerged from at least 10 years ago, and today is one of the important initiatives in the health sector. One noticeable problem though is the existence of many players in this field who have different electronic systems which are not inter-operable and integrated, whether Electronic Medical Record Systems (EMRs), mobile-health (mHealth) applications, or telemedicine systems. The presence of many implementers or vendors with different systems leads to fragmentation of e-health systems, which makes it difficult to provide continuum patient care and compile reports, among other things. This challenge exists in both developed and developing countries. In the West, international organizations such as the EU and WHO together with countries such as Canada, Australia and the UK began to place greater emphasis on interoperability and standards upon realizing the seriousness of having e-health systems that do not talk to one another (HIQA, 2011:5).

1.2 Definitions

It is essential to define key terms used herein for purposes of providing an understanding of the context in this paper. First, there are many definitions of e-Health, but the ones that are suitable for here are WHO's definition which states that e-Health is the use of information & communication technology for health, and HIMSS which defines e-Health as the use of technologies to improve access, efficiency, effectiveness and quality of clinical care and business processes, with an aim to improve health outcomes.

Interoperability is the ability of data and information generated by one system to be accessed and (re-)used in a meaningful way by another system, whether or not the latter is based on different technologies (Open Clinical, 2007). According to HIMSS, interoperability is the ability of the health information systems to work together within and across organizational boundaries in order to advance the effective delivery of health-care for individuals and communities. While integration means the linking together of an array of multiple information or data sets through a well-defined protocol and coordination of the merging of data from different systems within or across health facilities. HIMSS defines integration as the arrangement of an organization's information system in way that allows them to communicate efficiently and effectively, and brings together related parts into a single system.

Standards are basically technical specifications set to guide in the development of e-health solutions, to ensure quality, uniformity, easy access and so on. In order to achieve integration and interoperability, the areas on which standards are required include:

1.2.1 Architecture

This is the overall structure or plan for a health information system. It details components of the system and their relationships. It includes platform(s) on which applications are to be built. It states the design of the health information system and its ability to interface with other e-health systems.

1.2.2 Data Dictionary/ Vocabulary

This is a document with a list of clinical concepts, as a way of attempting to achieving uniformity in the concepts that e-health implementers use. This then would enable the sharing of data or information between different electronic systems. Moreover, standard conceptualization or understanding of clinical concepts helps to prevents medical errors or adverse events when treating patients.

1.2.3 Security

This focuses on data and system privacy and security. Health or patient data is sensitive and deserves to be kept confidential and the patients to have trust that their information will remain private even in electronic format. Thus, there must be standards in place that will ensure that every electronic health information system has security mechanisms that will prevent unauthorized access to the system, and loss or theft of data. Unique identification of patients and system users also need to be included.

1.2.4 Messaging standards

Another critical element is the institutionalization of the format and sequence for data transmission or interfacing between two or more different electronic systems. There must be a format that each implementer must use and therefore enable their systems to interface with others.

1.2.5 Networks and Infrastructure

There is also need to clearly define the kind of network and infrastructure for the national health information system. Each e-health implementer must know this and implement their solutions inline with this. This looks at connectivity, networks, power, and hardware solutions and so on. One of the critical aspects to also look at is robustness and sustainability of the same.

1.3 Justification for Interoperability, Integration and Standards in e-Health

The critical thing is to understand why e-health systems should be inter-operable, integrated and follows national or international standards. When e-health systems are interfaced or can communicate to one another, the benefits are distributable across patients, health-care workers, health facility managers, researchers and policy makers.

As e-health solutions target patients in order to improve health outcomes, patients' records ought to be continuous or their data should be transferable from one system to another, within

and across health facilities, particular for people who have lifelong sicknesses such as diabetes, hypertension and HIV (Ellingsen and Monteiro, 2008). When systems are developed followed agreed upon standards and become inter-operable, the systems exchange data or information accurately, effectively and consistently (Open Clinical, 2007). In this situation there is also improved access to health records and information, thereby enabling health-workers to easily access a patient's medical history when treating them, and to make informed clinical decisions.

Lastly, when e-health solutions are integrate or interfaced, generation of required reports in a health facility is not difficult, and this assists facility manager to be able to do forecasting and other important decisions based on evidence available to them. Such data is also useful to researchers and policy makers when it is aggregated and made available for their use.

2. Methods

A qualitative method was pursued to collect data for this paper. The techniques that were applied were chosen with a view to acquiring information, and deduce sound conclusions regarding the state of e-health initiatives in Malawi in relation to interoperability, integration and standards. The empirical data were gathered through a participatory approach, which included involvement of authors in work on e-health in Malawi, active engagement in National Data Standards Task Force meetings, and participation in workshops or conferences on e-health. All authors have also been involved in field visits for observations to health facilities and communities with electronic health systems. In 2012, four of the authors conducted an e-health situation assessment in the country by purposively sampling all 3 major cities' central hospitals, namely Queen Elizabeth Central Hospital in Blantyre, Kamuzu Central Hospital in Lilongwe and Mzuzu Central Hospital in Mzuzu. Secondary level public facilities and major mission and private hospitals in the three cities were randomly sampled, and the ones selected were Mlambe Mission Hospital and Mwaiwathu Private Hospital in Blantyre; Area 18 Health Centre, Nkhoma Mission Hospital and City Centre Clinic in Lilongwe; and MASM Clinic and St. John of God Mission Hospital in Mzuzu. One district in each of the three regions of Malawi was randomly selected and those selected were Thyolo in the south, Salima in the central and Karonga in the north, in which the district hospital participated in the assessment. Key informant interviews were also conducted with senior government officials and the leadership of main e-health implementers in the country. In addition, a desk review on published and unpublished literature on the topic was also conducted to complement primary data.

3. Findings

1.1 Existence of Different e-Health Implementers

To begin with, it is very apparent that Malawi has many players, big and small, that are implementing e-Health systems in public, mission and private health facilities. A table below attests to this point. These electronic systems are not yet inter-operable and integrated, apart from the few ones that have been highlighted in one of the subsequent sub-sections. This in itself also means that patients have to be issued IDs in each and every system which they interact with, as there is no one single unique identification system that can be used across the systems.

Figure #1: e-Health Systems and Providers in Malawi

#	Implementer	E-Health System(s)	Location
1. EMRs			
	Baobab Health Trust	ART, Out-Patient Diagnosis (OPD), General Patient Registration, Antenatal, Maternity, Diabetes, TB-HIV, Pharmacy, HIV Testing & Counselling (HTC), Chronic Care Clinic, Lab, and so on.	All districts in Malawi, except two (common in most sites are the first two systems) – district hospitals, health centres and mission hospitals
	Luke International	Paxi - radiology	Mzuzu Central Hospital in Mzuzu
	MSF - France	Fuchia (ART)	10 health facilities in Chiradzulu
	Nkhoma Mission Hospital	Afyapro (facility wide system)	Nkhoma Hospital in Lilongwe
	Partners in Health	ART	Neno
	Dream Project	ART	Dream Clinics in Lilongwe, Blantyre and Balaka
2. Mobile Applications			
	D-Tree	Maternal-Child Health system, PMTCT	Lilongwe and Dowa Districts
	COOPI	Pharmaceutical Stock Management	Salima District
	Village Reach/ Baobab Health	Maternal-Child Health system	Balaka District
	Medic Frontline SMS	ART	St. Gabriel's Hospital in Lilongwe, and Machinga District
3. Telemedicine			Kamuzu Central Hospital in Lilongwe and Queen Elizabeth Central Hospital in Blantyre
4. Logistics Management Info. Systems			
	JSI		Selected districts in Malawi

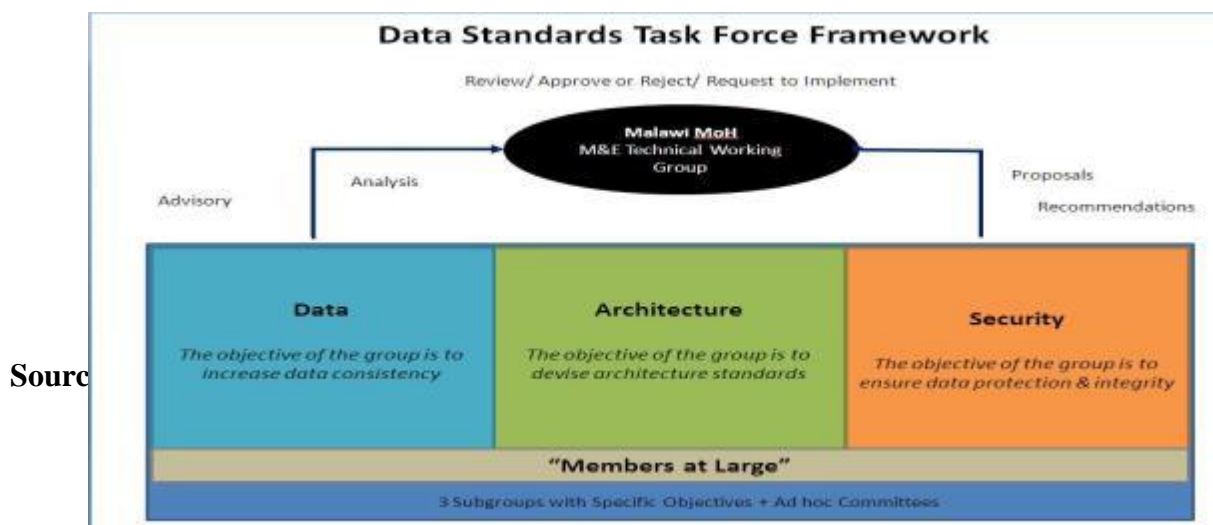
Source: Authors' input

The above systems do not communicate with each other because they are built on different data models and use different operating systems. For example, Baobab Health uses OpenMRS data model, MySQL database, Ruby-on-rails as programming framework and Linux operating system; Luke International uses Microsoft SQL database, Visual Basics 6.0 and Microsoft Windows operating system; D-Tree uses Microsoft Windows and Android applications; and Afyapro uses Microsoft SQL database and Microsoft C#.NET.

1.2 MoH established the National Data Standards Task Force

The MoH created the National Data Standards Taskforce within the national M&E Technical Working Group years ago, in order to achieve the following: formulate policies and standards to guide implementations of health information systems, monitor implementations of partners in this area, and provide a forum at which implementers or stakeholders can update each other on their work, share knowledge and experiences, and partner in some interventions. Below is a diagram illustrating the structure of this Task Force.

Figure # 2: Structure of National Data Standards Task Force in Malawi



Furthermore, within the same Task Force, a mHealth Task Force was established to purely focus on mobile applications for health, due to the growing number of new implementations in the area. This then offers implementers additional time to discuss issues pertaining to their field, share experiences and collaborate in some projects.

1.3 Data Sharing Between/ Across Electronic Systems

Sharing of data whether patient health records or aggregate information in the health sector is very crucial for several reasons, as alluded to earlier. When this sharing of information is done electronically the process is simple, efficient and saves time of the responsible staff. With ICT systems that are inter-operable, it is possible to automatically exchange patient data from a laboratory system to an electronic medical record system within a hospital, or to transmit digital x-ray images electronically across health facilities or institutions (e-Business Watch, 2008:12). It was, therefore, in-line with this scenario that the MoH decided to make sure that all electronic systems in the health sector in Malawi can transmit data between and across systems. As such, it mandated all e-health implementers in the country to develop and deploy systems that are compliant with the HL7 Standard Messaging system.

1.4 E-Health Strategy Development

In 2012, MoH commissioned an assessment for e-health situation in the country, in order to understand the initiatives that are already in place in health facilities, whether public, mission or private, as well as the gaps that exist. This was critical for it to better develop a national strategy for e-health, which all stakeholders must know and follow in their work in this sector. The strategy is one way of ensuring that all players are guided, and that are working towards the national vision and adhering to standards. Therefore, a multi-disciplinary team was constituted to undertake this exercise and the situation assessment was completed in the same year, but the final e-Healthy Strategy for Malawi was finished in 2013.

1.5 Partners Initiatives

It must be stated that few partners collaborated on their own to integrate their e-health systems and to enable and then demonstrate interoperability of their systems. In mid-2012, Baobab Health Trust which mainly implemented EMRs in the central and southern regions and Luke International which operated in the northern region reached an agreement to *merge functionalities* of their Electronic Medical Record Systems (EMRs) and come up with one called National EMR.

Between 2012 and 2013, MSF Belgium which had deployed Fuchia ART system with which it managed all ART patients within Thyolo District, approached Baobab Health for discussions to *migrate* their health facilities into the Baobab Electronic Medical Record system, which is a de-facto national EMR. The migration was successful and now the new EMR is in use at Thyolo District Hospital and Bvumbwe Health Centre. In 2014, Baobab Health worked closely with MoH to enable the OPD system, which operates at patient level, to *transmit data* to the District Health Information System (DHIS), which focuses on district aggregate data. Within few months the two systems became *inter-operable*, and below is Figure # 3 that represents this interoperability.

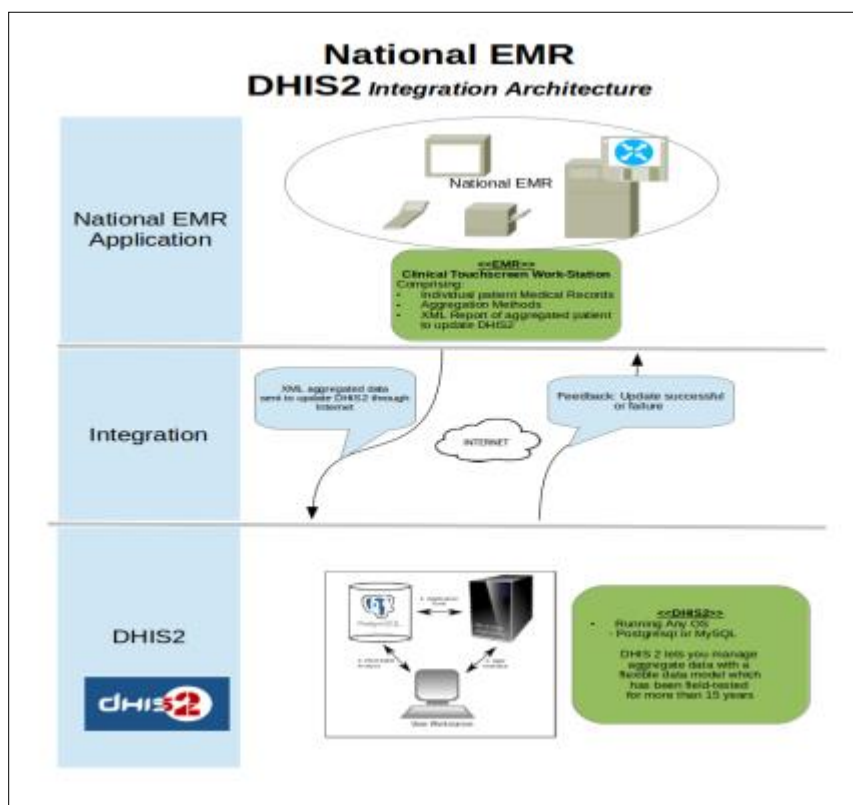


Figure # 3: Source: Lupafya (2014) unpublished

4. Discussion

1.1 State of Integration and Interoperability

It is clear from above that the presence of various different e-health interventions in Malawi has led to lack of interoperability and integration of the systems. The challenges that this brings have already been alluded to in the foregoing. But the major one is that all the systems deal with a patient and for people that are on lifelong illnesses it presents problems when the

interact with those different systems as their records cannot be shared across the systems. The work that the National Data Standards Task Force is doing has been well recognized. But the task force must work on the shortcomings which are stated below, in order to make good progress in its work.

Even in the absence of national standards in black and white, and mechanisms for enforcement, some partners have collaborated and demonstrated standards within the field as highlighted earlier. This is facilitating continuum of care for patients when they move from one district to another across the country e.g. HIV patients who are on ART treatment.

1.2 Short-comings

First, it must be acknowledge that even though there are efforts to come up with national standards on e-health, the process is taking long to finalize the same. This then means that the country does not officially have the said standards on paper, which are enforceable. It is yet to be known even when they are institutionalized whether there will be incentives for those that follow and punishments for those that do not follow the national standards.

In the event that Malawi has official national standards for e-health, the critical question then will be whether the country has a clear framework for monitoring and enforcing compliance. At the moment, this is absent and in current discussions and efforts towards establishing standards there should also be some focus on this framework.

Another major inadequacy is shortages of financial, human and infrastructure with which to initiate, or to support e-health. The MoH does not receive adequate funding from the central government for all its operations, and therefore, interventions such as e-health do not receive much attention and resources. At present, almost all e-health interventions in the country are initiated by donors and NGOs. The disadvantage of this is that it is these donors and NGOs, in some cases, which influence the direction of the interventions, as they seek these to be in-line with their interests.

1.3 Prospects

It is essential to highlight that one major prospect now is that institutionalization of national standards and the attainment of interoperability and integration of e-health systems is possible in Malawi. This is so because at present most electronic health systems are still in pilot phase or have been deployed in just few health facilities. This is very different in countries such as the USA, UK, Australia and others that experienced major problems due to lack of interoperability and integration of e-health systems, as the domain became flooded with many private vendors' systems which could not communicate with each other. In case of e-health systems that are mature and have been deployed to many hospitals, such as Baobab's ART, OPD and Antenatal modules, the coding took into account the HL7 compliance requirement set by MoH. This, together with the presence of a local team of software developers and engineers who develop and deploy the systems, will enable their interoperability with other systems in the future.

As stated in the foregoing as well as by Kanjo et. al. (2008:5) another good prospect in the country is the existence of the National Data Standards Task Force (NDSTF) which is led by MoH. This task force basically offers an opportunity for agreeing on and enforcing national standards. In terms of the standards in question, the members and MoH discusses these and

have sub-groups that have been assigned to look at domains such as architecture, data dictionary and security. There seems to be some delays in finalizing the assignments of coming up with final documents from the sub-groups that guide the members in terms of national standards, as those assigned to do this work have other responsibilities within the organizations they work for. Additionally, the task force enables members to share best practices, which in a way can also set standards among the membership. It must also be stated that the NDSTF is best placed to stir interest and willingness of the member organizations to get involved in its activities, and with their presence, therefore, facilitate the adoption and adherence to agreed upon national standards and policies concerning e-health.

Lastly, the e-Health Strategy for Malawi is another key document that when institutionalized, it will guide e-health implementations in the country. It will provide some kind of direction and indication of what MoH seeks to achieve within this field. Knowledge of this is key to enabling stakeholders start interventions which are aligned to the national strategy.

5. Conclusions and Recommendations

The presence of various e-health initiatives in Malawi that are built on different platforms and operating systems, coupled with the patient centred nature of health-care delivery, demands the need to have e-health systems which have national standards that make them interoperable and integrate with other systems in the health sector. The paper has highlighted key implementers of e-health systems in Malawi, mainly EMRs and mHealth, with an indication of their systems and platforms on which they are built. There are efforts both by MoH and some e-health implementers themselves that have been undertaken to harmonize things and integrate some of their work. MoH is also leading the National Data Standards Taskforce which seeks to formulate and enforce national standards in this sector.

It can be argued that the process of putting together the said standards and achieving interoperability and integration in Malawi is very slow, and there seems to be no clear road map with which to achieve the same. Therefore, MoH must work with all stakeholders to create a road-map for achieving interoperability and integration of systems in the country. The paper also argues that Malawi ought to have national standards and have systems talk to each other sooner, when most systems are either in pilot phase or have not been rolled out to many places; than doing it latter when it will be more complex and costly exercise. As in each system a patient, a system user (health-worker) and a health facility are issues a unique identifier, it does not make sense for one patient to have several IDs. This then calls for the need to implement national unique identifiers which can be used across e-health systems sooner than later. The paper also urges the government to dedicate adequate resources to e-health and determine its course based on its national interest(s), as currently this area is largely donor funded and therefore a big influence on direction of the initiatives is based on interest of the donors in some cases. Furthermore, MoH should have a clear framework or mechanism for monitoring and enforcement in the e-health sector, in order to ensure that all system implementers are adhering to national standards. Lastly, the issue of sustainability must also be fully discussed and addressed with all the players.

References

Brailer, D. (2005). *Interoperability: The Key to the Future Health Care System*, in *Health Affairs* (2005): pp.W5.19-W5.21.

Dogac, A., (2014). *Key Issues of Technical Interoperability Solutions in e-Health and the RIDE Project*. www.srdc.com.tr/publications/2007/eChallengesRide2007.pdf [accessed 5th November, 2014]

e-Business Watch. (2008). *ICT Standards in the Health Sector: Current Situation and Prospects*. [accessed 3rd November, 2014] www.ebusiness-watch.org

Ellingsen, G. and E. Monteiro. (2008). 'The organizing vision of integrated health information systems'. *Health Informatics Journal*. 14, (3) pp. 223-236.

Hammond, W.E. and J.J. Cimino. (2001). *Standards in Medical Informatics*, in *Medical Informatics: Computer Applications in Health Care and Biomedicine*. Springer: New York.

Health Information & Quality Authority (HIQA). (2011). *Developing National e-Health Interoperability Standards for Ireland: A Consultation Document*.

Kanjo, C., et. al. (2008). *Institutionalizing the Integration of Health Information Systems through Stakeholder Buy-in: The Case of Malawi*. IST-Africa 2008 Conference.

Lupafya, C. (2014) Baobab *EMR Integration with DHIS 2A* presentation made during a M&E Technical Working Group of MoH held in Lilongwe in February, 2014.

Ministry of Health. (2012). *Malawi Health Sector Strategic Plan*. Lilongwe: Ministry of Health. 148p.

Mwakilama, S.G. and M. Monawe. (2013). *Malawi E-Health Strategy Situation Assessment Report*. http://conf.helina-online.org/public/Helina2014_proceedings_v5_part1.pdf pp. 67-78.

Open Clinical, *Interoperability in Health Information Systems*. <http://www.openclinical.org/interoperability.html> [accessed 5th November, 2014]

WITSA. 2006. *Health Care and Information and Communications Technologies: Challenges and Opportunities*. <http://www.witsa.org/papers/WITSA-HIT-final.pdf> pp.11.

World Health Organization (WHO). www.who.int

Zaitun, A.B., et. al. (2000). 'Systems Integration for a Developing Country: failure or success? A Malaysian Case Study.' *Electronic Journal of Information Systems in Developing Countries*. 3(1), pp. 1-10