# Health Informatics Capacity Building in Uganda

# Saul Lugoye

A dissertation submitted to the University of Dublin, in partial fulfilment of the requirements for the degree of Master of Science in Health Informatics

# 2011

# **Declaration:**

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### Abstract:

World-wide, health informatics has been cited as a key factor that enables the transformation of the Healthcare sector into the technological age (Haux, 2010), as it focuses on the capturing, modelling, managing and sharing of health data, which is then processed into knowledge that can be used to formulate evidence-based clinical and managerial decisions (HISA 2011; TCD 2011; UCL 2011).

Health Informatics has a direct impact on the health sector enabling it to realise savings in terms of money, time and effort. More importantly, health sectors are able to improve patient care which serves the ultimate goal of health care.

Like most developing countries, Uganda is at present embracing health informatics into their work-processes, however, there is still a lack of capacity in terms of infrastructure and general capability to lead and implement health information transformation (HSICTP 2006; NHP 2009; Vision-2012 2009; HSSP-III 2010).

This study sets-out to explore the possibility of how Uganda could build capacity in Health Informatics through the provision of a teaching and research centre, at one of its main and oldest academic institutions, Makerere University, in an attempt to improve the efficiency and effectiveness of the healthcare services delivery and patient care.

"Qualitative Research" methodology was applied in the research combining techniques such as structured interviews, informal interviews, questionnaires and observation (through workshops) in order to gather information that could contextualise and compare information to that gathered in the literature review. This also enabled the research to ensure that the goals and objectives of the study remained in.

The study focused on the importance and role of stakeholders including third parties that could support the venture of a training and research centre in order to leverage on standards and content that had already been tried and tested in the industry. The study also looked at frameworks to determine how academic institutions designed their course content and duration, target audience and what entry levels they catered for.

Based on the findings from the research, the study will formulate recommendations to the Uganda's Ministry of Health, in collaboration with the Colleges of Health Science and the Computing and Informatics Science, to provide them with informative guidance in the form of the steps to undertake in the initiation and implementation of the Health Informatics capacity building programme.

The study concluded with additional support information and advice that can aid future development and thus be incorporated in their project to establish a training and research centre ensuring the effort is sustained and meets the needs of Uganda's health sector.

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# **ACRONYMS, INITIALISMS AND ABBREVIATIONS**

Entry	Definition			
AMIA	American Medical Informatics Association			
ASeH				
AUC	African Union Commission			
B.Sc.	Bachelor of Science			
BPO	Business Processing Outsourcing			
CDMA	Code-Division Multiple Access (protocols used in second-			
	generation (2G) and third-generation (3G) wireless			
	communications.)			
CHI Canada Health Infoway				
CHIME	Centre for Health Informatics & Multi-professional Education			
CIO	Chief Information Officer			
DRC	Democratic Republic of Congo			
ECTS	European Credit Transfer System			
GDP	Gross Domestic Product			
GH	General hospital			
GoU	Government of Uganda			
GP	General Practitioner			
<b>GSM</b> Global System for Mobile Communications (World's most				
	popular standard for mobile telephony systems)			
HIR1/2	Health Informatics Respondent 1 or 2			
HMIS	Health Management Information System			
HSICTP	Health Sector ICT Policy (Draft)			
HSIOR	Health Sector Information Official Respondent 1			
HSSIP	Health Sector Strategic and Investment Plan			
HSSP	Health Sector Strategic Plan			
ΙΦΕ	The International Partnership for Health Informatics Education			
ICT	Information Communication Technology			
IMIA	International Medical Informatics Association			
IPHIE	The International Partnership for Health Informatics Education			
IT	Information Technology			
KBIS	Knowledge Based Systems, Inc.			
MDG	Millennium Development Goals			
M.Sc.	Masters of Science			
MoES	Ministry of Education and Sports			
MoFPED	Ministry of Finance, Planning and Economic Development			
МоН	Ministry of Health			
MoICT	Ministry of Information and Communication Technologies			
MoLG	Ministry of Local Government			

MoLGSD	Ministry of Labour, Gender and Social Development			
MoWC	Ministry of Works and Communications			
NDP	National Development Plan			
NeGP	National e-Governance Policy			
NFP	Not for Profit			
NHISP	National Health Information Policy February 2011			
NHP	National Health Policy			
NHS-UK	National health Service – UK			
NICTP	National ICT Policy 2006			
NIMIS	National Integrated Medical Imaging System			
NITA-U	National Information Technology Authority Uganda			
NRH	National Referral Hospitals			
PEAP	Poverty Eradication Action Plan			
Ph.D.	Doctor of Philosophy			
R&D	Research and Development			
RLP	respective legal proprietors			
RRH	Regional Referral Hospitals			
SCSIR	School of Computer Science and Informatics Respondent			
SPIDER	Swedish Program for Information and Communication			
	Technology in Developing Regions			
STI	Science Technology and Innovation			
UBOS	Uganda Bureau of Statistic			
UKHIS	United Kingdom Health Informatics Society			
<b>UMTS</b> Universal Mobile Telecommunications System (one of the				
	generation (3G) mobile telecommunications technologies, which			
	are also being developed into a 4G technology)			
UNDP	United Nations Development Programme			
MUK	Makerere University - Kampala			

 Table 1: Acronyms, Initialisms and Abbreviations

# CHAPTER 1 INTRODUCTION

#### **1.** INTRODUCTION

#### 1.1. Problem Statement

Could building capacity in Health Informatics improve the state of health informatics systems in Uganda, which would in turn, improve the quality of patient care and service delivery in the health sector?

#### **1.2. Research Objectives**

The main objective of this study was to investigate how Uganda could build capacity in health informatics using a combination of skills, knowledge and judgement, by establishing a health informatics research and training centre of excellence in Makerere University.

#### 1.3. Research Aims

This study was aimed at examining how Uganda's health sector together with other partners, such as academic research and training institutions as well as Non-Governmental Organisations and overseas partners could collaborate together and build capacity in health informatics.

The study endeavoured to explore the possibilities of:

- Establishing a health informatics research and training centre of excellence in Uganda
- 2) How to identify critical persons or groups with a direct interest, involvement, or investment (stakeholders) who will take part in initiating the objective of the study
- 3) How the stakeholders will go about the process of designing the health informatics academic curriculum based on local needs but guided by the International Medical Informatics Association's recommended framework
- 4) What type of infrastructure is required as well as the most suitable location to host the health informatics research and training centre
- 5) What would be the future strategic direction for the centre to ensure that it meets its objectives of meeting the health informatics needs of the health sector?

#### 1.4. Brief Background of Uganda's Health Sector

The Uganda's Ministry of Health (MoH-U) has an obligation to "facilitate the attainment of a good standard of health by all people of Uganda in order to promote a healthy and productive life", which is reflected in the Uganda National Minimum Healthcare Package, National Development Plan (NDP) and Health Sector Service Plan (HSSP)(Vision-2012 2009; HSSP-III 2010; NDP-2015 2010).

Between 1962 and 1971, Uganda had one of the best healthcare systems compared to other African countries. Unfortunately this collapsed due to political instability over two decades. Since the early 1990s, the government of Uganda has prioritised the reconstruction of the Health Sector in both the NDP and Millennium Development Goals (MDG) agendas (NDP-2015 2010).

The main goal of Uganda's Health Sector Information and Communication (ICT) Policy is to "Promote effective Development, Deployment and Exploration of ICT for quality healthcare" (HSICTP 2006), and it expects to attain this goal by ensuring:

- The realistic approach in the selection, deployment and "operationalisation" of ICT which is cost-effective and employs interoperable technology That healthcare professionals are equipped with the necessary ICT and technological skills
- 2) The quality, appropriate and affordable health informatics systems and services are provided to all target groups
- 3) That the development of information and communication systems is based on existing information in order to remain relevant to the target groups
- That communication services such as Internet access, telephone access, and media including radio and Television, are available
- 5) That the appropriate content is readily available for both healthcare providers and consumers
- 6) That the appropriate information security and confidentiality are implemented, maintained and adhered to at all times, as well as ethical standards, guidelines and polices.

The Health Sector is composed of public, private, community and non-governmental sectors, all with the primary aim of providing and sustaining good quality healthcare (NHP 2009).

The health sector framework is divided into two sub-categories (i.e. districts and sub-districts), with a structure of National and Regional referral hospitals, general hospitals, and Health centres (i.e. level II, III and IV)<sup>1</sup>(HSSP-III 2010).

Health Centre I (HC I) does not have a physical structure. It comprises of a team known as the Village Health Team who provide a link between health facilities and the community.

Health Centre II (HC-II) provides the first level of interaction between the formal health sector and the communities. HC IIs only provide out patient care and community outreach services. This facility serves a few thousand people and should be able to treat common diseases like malaria and is led by an enrolled nurse, working with a midwife, two nursing assistants and a health assistant.

Health Centre III (HC-III) provides basic preventive and curative care as well as laboratory services for diagnosis, maternity care and first referral cover for the subcounty and also operate under the jurisdiction of HC II.

Health Centre IV (HC-IV) Offers services similar to HC III, but should have wards for men, women, and children and should have a senior medical officer and another doctor as well as a theatre for carrying out emergency operations.

General hospitals (GH) offer in-patient health services, laboratory, blood transfusions, maternity, surgery, medical imaging, and preventive services. They also offer consultation, research and training in community-based healthcare programmes. There are 43 GH serving over 0.5 million people and under the Ministry of the Local Government.

Regional Referral Hospitals (RRH) offer clinical specialised services such as Ear, Nose and Throat, critical surgical and medical services, psychiatry, etc. As in GH, RRH also provide research and training services. There are 11 RRH serving over 2 million people and are governed by the Ministry of Health.

<sup>&</sup>lt;sup>1</sup> http://www.guardian.co.uk/katine/2009/apr/01/uganda-healthcare-system-explained - 01/09/11

However, there are two National Referral Hospitals (NRH) serving over 30 million people. They are set up to offer comprehensive specialist services and are involved in health, teaching and training, and other services offered by GH and RRH.

Hospitals	NRH	RRH	GH*	Private/ NFPs			
Number of Hospitals	2	11	43	42			
<b>Population Cover</b>	30 Million	2 Million	0.5 Million				
<b>Governing Body</b>	Autonomous	MoH	MoLG	RLP			
All hospitals provide support and supervision to lower levels and to maintain links with Community Health Departments. RLP: respective legal proprietors							
<b>Fable 7:</b> Summary of Public and Private Healthcare institutions – (Source: Extracted							

**Table 2:** Summary of Public and Private Healthcare institutions – (Source: Extracted from the(HSSP-III 2010))

Figures in the Millennium Development Goals (MDG, 2010) reaffirm that there are 114 Hospitals in Uganda, and in 2009, there were 3,318 healthcare centres, which reflect an increase of 0.92 % based on the figures of 2007.

#### **1.5. Motivation and Justification**

#### 1.5.1. Why Build Health Informatics Capacity in Uganda?

Building capacity in Health Informatics is essential to Uganda's healthcare services, which continue to suffer budget reductions as well as limited resources.

World-wide, health informatics has been cited as a key factor that enables the transformation of the Healthcare sector into the technological age (Haux, 2010) and evidence shows that currently, health sectors around the world are incorporating ICT into their strategic plans and policies.

Healthcare professionals have recognised the need for health informatics in various areas of the healthcare services and as a result, the importance of this subject continues to increase within the healthcare work processes (Hovenga 2004), with exciting career prospects for various professionals in the healthcare services (CHIME 2011; UCL 2011).

Developing nations are now seeking ways to improve the efficiency and effectiveness of their healthcare services while reducing the operational costs, by integrating ICT technologies into the current work processes (Ammenwerth, Haux et al. 2003; Omona and Ikoja-Odongo 2006; NHP 2009; HSSP-III 2010). The continuing fall in hardware and software prices as well as the increasing development and usage of the Internet has also contributed to the feasibility of these implementations (McLaughlin, 1999; Shartlieffe, 2001).

Similarly, Uganda's health sector is also gradually embracing and integrating information technology into its existing work processes, but like many developing countries, Uganda is experiencing a shortage of qualified professionals in Health Informatics, which presents challenges of its own.

Satisfactory management of health informatics systems is a critical factor to the success and future of the health sector (Musen (2002). Implementation of ICT in healthcare is widely considered to have a huge impact on the improvement of the healthcare service delivery and quality of patient care (Ammenwerth, Haux et al. 2003)(Institute of medicine, 2001).

Good quality health data based on the recommended health sector standards is essential for policy-making, planning, management, monitoring and evaluation, research and patient care usage. Therefore, it is imperative, that the captured data is comprehensive, timely, accurate, complete and reliable (Vision-2012 2009).

Quality health data provides healthcare professionals with the ability to:

- Make evidence-based clinical decisions
- Allocate necessary resources based on the analysed need
- Plan and formulate essential guidelines and policies to be implemented.

According to the WHO (2009 - 2014), timeliness and completeness of health informatics systems have greatly improved in Uganda. However, there is still a need to further develop these systems and also improve the quality of data collected.

This can only be achieved if the information captured is of a high quality and is gathered and managed in a coordinated and harmonised manner throughout the entire health sector, to ensure that the data is compiled, analysed, used and reported within the system in an accurate, timely, and cost-effective manner (Vision-2012 2009).

According to Dr. Eddie Mukooyo the Assistant Commissioner of the Resource Centre of Uganda's Ministry of Health, supporting partners such as the Government of the United States have invested heavily in improving Uganda's Health Informatics Systems, thus ensuring that quality health data is captured (Data-Use 2010).

Despite ongoing efforts to improve health system performance, health systems remain very poor, due mainly to lack of human capacity (skilled manpower) in the healthcare services, inadequate funding to develop and maintain both information systems and the relevant technologies and the lack of standard policies across the board.

#### **1.5.2.** Challenges in Health Informatics

Most of the health informatics systems are fragmented at Public, Private and Community levels, due to the fact that data is frequently collected to meet the needs of specific constituencies and kept in proprietary systems, the collection of data is left to the data managers' discretion and there is no standard means of disseminating the information (Vision-2012 2009; Data-Use 2010).

There is duplication of services at all health facility levels, which leads to healthcare professionals spending significant amounts of time manually collecting the same data for use at different healthcare facilities and services.

Other challenges include the lack of collaboration between hospitals, academic institutions and solution providers (HSICTP 2006), despite the HSSP's efforts to encourage partnership formations with the relevant bodies in the health informatics system, in order to start developing harmonised projects as well as studies (HSICTP 2006; HSSP-III 2010).

Other challenges that hamper the development and sustainability of health informatics systems within the health sector include (Vision-2012 2009):

- The lack of quality data collection policies and mechanisms within the health centres
- The inability to capture private provider's and community based data and integrate it with the public data sets

- The lack of formal training for health informatics managers on usage and implementation of health informatics systems
- Lack of computerised health management information systems at most of the healthcare facilities
- 5) Lack of defined and clear information management pathways
- 6) Poor feedback mechanisms from participating healthcare centres due to inadequate communication strategies
- 7) The lack of a comprehensive information strategy at the MOH which aligns the needs of health data users or consumers with data generators or producers
- Poor recruitment and capacity building, leading to understaffing and an inadequate skill base in staff at facilities, districts and central level (records assistants, statisticians, demographers, epidemiologists, etc)
- Inadequate/insufficient resources leading to partial implementation of the Resource Centre's functions
- 10) Poor coordination of health informatics activities within the MOH and with other key partners involved in the generation of health related data
- 11) The lack of availability and interoperability of health informatics systems
- 12) The lack of a national identity card and unique client identifier system to facilitate integration of data collection, storage and use at facility, district and national level
- 13) Poor levels of reporting by private health facilities and non-compliance to national HMIS reporting requirements
- 14) The lack of ICT standards for health data management (hardware and software)
- 15) Poor ICT infrastructure at most of the lower level facilities
- 16) Poor information utilization culture at different levels of the health system

17) Poor change management, operation and maintenance and standardisation related to ICT solutions used by the health system.

It is the responsibility of Health Informaticians to advise the relevant stakeholders on how to collect high quality data, analyse the collected data and finally disseminate the results to those who require to utilise them (e.g. Clinicians, Health administrators, Policy Makers, etc).

Despite the demand for qualified information managers with specialised training in health informatics, who will participate in the implementation, training, formulation of policies and the standardisation of procedures and guideline, at present, there are currently no educational institutions in Uganda which offer such training in these skill sets.

Therefore, there is an urgent need to establish a teaching and research centre for health informatics professionals in Uganda, a need which has been highlighted by the Ministry of Health, the College of Computer Science and Information Science, the College of Health Science in Makerere University, international participating partners such as the Centre for Disease Control and the prospective healthcare professionals who require this service.

#### 1.5.3. Why Host Health Informatics in Makerere University?

Makerere University is one of the main and is the oldest academic teaching and training institution in Uganda. It was founded in 1922 under the name of Uganda Technical College, training students in the disciplines of carpentry, building and mechanics. In 1949, it became a University College, and was affiliated to the University of London, offering general degree courses until June 1963, when it became part of the East African University. In 1970, Makerere became an independent academic university of Uganda, offering training to undergraduates and postgraduate students.

Makerere University has a vision of "building capacity through training and research" as well as being "the leading institution for academic excellence and innovations in Africa"(MUK-Vision 2011).

Currently, Makerere University comprises twenty-two faculties/ institutes/ schools, offering full-time and part-time study programmes to over 33,000 undergraduates and 3,000 postgraduates (CHUSS 2010).

The University is affiliated to many academic and research institutions at local, regional and international level, participating in various teaching and research collaborations and therefore "encourages creation of multidisciplinary research teams that can competently generate knowledge to address societal needs (COCIS 2010).

The College of Computing and Information Sciences (COCIS) evolved from the Faculty of Computer and Information Technology in 2010. It is made up of the School of Computing and Informatics Technology (CIT) and the East African School of Library and Information Science (EASLIS). COCIS is one of the largest computing and ICT training, information science, research and consultancy colleges in Africa (COCIS-Web 2011).

It has an infrastructure estimated at over \$200 million worth of assets, which include lecture theatres, large computer laboratories, specialised computer laboratories and a college library. The COCIS facilities can accommodate over 10,000 students (COCIS-Web 2011).

It offers 13 graduate programmes (see Appendix 10) and has over 50 local and international collaborations with Universities, Corporations in the Private and Public sectors.

The College has been actively providing supervision in health informatics research and is involved in the publication of the "International Journal of Computing and ICT Research (IJCIR)<sup>2</sup>.

The College is involved in a number of research projects in the areas of Machine learning, Security, ICT for development, Modelling and web based systems, E-Learning, Mobile computing and communication, Records Management Education, Information Policy and Publishing, Knowledge Management and ICTs for Libraries.

The College of Health Sciences was established in 2007, after being upgraded from the faculty of Medicine in 2004 and prior to that as a Medical School of a University College in the early 1900s. It is made up of four schools, the school of Biomedical Sciences, Health Sciences, Medicine and Public Health as illustrated in Appendix 11.

<sup>&</sup>lt;sup>2</sup> <u>http://ijcir.org/home/</u> - 01/09/11

The school is located at Mulago National teaching and referral hospital and it shares the vision of "a centre of academic excellence" with the mission dedicated "to improving the health of the people of Uganda and beyond", while "providing and promoting the quality of Education, Research and Healthcare Services".

As seen from the above testimony, the two colleges have been established for quite some time, providing teaching and research at undergraduate, postgraduate and Doctor of Philosophy programmes in a number of disciplines.

Both schools have the basic resources and infrastructure (i.e. computer laboratories, lecture theatres, qualified and experienced academicians, experienced management and administrative teams, Information services support, etc.) to support an extra programme despite the current economic climate and existing local challenges such as low wages, poor power (electricity) infrastructure, limited numbers of human resource, etc.

There are also courses offered at postgraduate level, which are identical to those which could be offered in Health Informatics, from the College of Computing and Information Science as well as the College of Health Science. Placing the Health Informatics programme in one of these schools will offer the opportunity to share inter-linking course programmes between the two schools as well as minimise human and running costs.

The School of Computer Science and Informatics together with the School of Biomedical and Public Health expressed interest in getting involved and supporting the main objective of this study, which is establishing a health informatics teaching and research centre.

#### 1.5.4. Summary

This chapter introduced the research aims and objectives of the study, including a brief background of Uganda's health sector. This was followed by highlighting the importance of building capacity in Health Informatics, in general and in particular, Uganda, as well as insight into the academic institution, Makerere University, and the two schools most likely to be able to facilitate and host a new Health Informatics training and research programme, namely the College of Computing and Information Sciences in conjunction with the College of Health Sciences.

# CHAPTER 2 HEALTH INFORMATICS

#### 2. HEALTH INFORMATICS

#### 2.1. Introduction

Health Informatics is a complex and intellectually demanding crosssectional discipline which focuses mainly on the capturing, managing, structuring and sharing of health data and knowledge, in order to facilitate the analysis and decision making by healthcare professionals (Haux 2010; UCL 2011).

Health informatics is not only about technology in healthcare, but rather provides a link between technology, information and people, aimed at improving the overall efficiency and effectiveness of service delivery and patient care (TCD 2011).

Various publications use different various terms such as "medical informatics", "Health Informatics", "Bioinformatics" or" Biomedical Informatics" interchangeably and rarely do they offer definitions or explain similarities and difference between these terms.

#### 2.2. Definitions

Norris and Brittain (2000) formulated three categories in a bid to minimise the confusion and obtain an appropriate definition, which were:

- Information for clinical purposes
- Information for the management of healthcare systems
- Information in the study of general health trends such as epidemiology,

where category (a) and (b) may be classified as health or healthcare informatics, and (c) is referred to as epidemiology.

(Imhoff, Webb et al. 2001) defines health informatics as the "development and assessment of methods and systems for the acquisition, processing and interpretation of patient data with the help of knowledge from scientific research".

Enrico Coiera (2003) describes Medical Informatics is "the study of how medical knowledge is created, shaped, shared and applied."

(Haux, Ammenwerth et al. 2004) broadly and comprehensively describes the term health and medical informatics as the discipline which deals with the systematic processing of data, information and knowledge in health and medical care.

Health informatics, or medical informatics, has been defined as the intersection of information science, computer science, and healthcare, as it combines information science and information technology, and mainly deals with the acquisition, storage, retrieval, and application of health informatics through better data management, analysis, and dissemination methodologies (KBSI 2011).

The term bioinformatics may have originated from the study of informatics processes at the beginning of the 1970s. (Hogeweg 2011) tried to define the interpretation of the properties of life information processing at multiple levels including accumulation during evolution, information transmission from DNA to intra and intercellular processes.

However, (Miller 2000) defines bioinformatics as the discipline studying the applications of informatics to the medical, health, and biological sciences, and it is restricted to the applications of informatics in such fields as genomics and the biosciences.

Medical informatics is also a more specialised area which may be populated mainly by medical physicists, scientists and technologists, while health informatics incorporates public and clinical health and also non-clinical health workers.

Though the history of medical informatics spans longer than that of health informatics, both terms refer to the application of ICT towards supporting the healthcare processes and procedures such as diagnosis and treatment (Norris and Brittain 2000). However, the term health informatics is gradually replacing the older, but widely used term "medical informatics", which refereed to the computerisation of healthcare in the past 10 to 20 years (CHIME 2011).

#### 2.3. Role of Health Informatics

The health informatics discipline is dedicated mainly to the awareness and appreciation of skills, tools and knowledge which allows the sharing and utilisation of information in a healthcare setting, with the goal to promote and improve the quality of services delivered (Chaudhry, Wang et al. 2006; TCD 2011; UCL 2011).

According to (Hersh 2009), Health Informatics is a discipline which focuses mainly on the aspects of the acquisition, storage, and utilisation of the collected information in a specific healthcare setting. Appendix 2 provides a detailed illustration of how (Hersh 2009) described other disciplines which are involved in Health Informatics.

Health Informatics is more about information than technology as it forms the intersection between "People, Information and Technology", to enable communication, decision making, sharing information and knowledge in real-time within the complex healthcare work environment as illustrated below:



**Figure 1:** Categories which make up the Informatics field – Source: Adapted from (Hersh 2009) The Australian eHealth Standards (ASeH 2011) describes it as a "discipline of using computing, networking and communications – methodology and technology – to support the health related fields, such as medicine, nursing, pharmacy and dentistry".

The (UKHIS<sup>3</sup>, 2008) describes health informatics as "an essential and pervasive element" in all healthcare activities, and continues to be developed and pursued by academicians as well as health professionals and research communities who are involved in its teaching, implementation and advancements.

(Jaspers and Hasman 2007) suggest that Health informatics goes beyond the design, development and implementation of health informatics system, and therefore not only requires specialised ICT skills and technological knowledge, but also requires the ability to address a wider range of healthcare informatics related challenges.

In summary, the principal role of health informatics is aimed at improving and enhancing the quality of services delivered and patient care in the health sector (Jaspers and Hasman 2007).

#### 2.4. Challenges in Health Informatics Capacity

Education is considered to be the key component of quality human capital and has been identified as an essential element in poverty eradication, as it plays a vital role in higher income and sustainable economic growth (PEAP, 2004).

Building capacity in the form of education and training enables personnel to acquire professional skill sets which are essential to an organisation's productivity and service delivery (NDP). However, Uganda's health sector is hampered by inadequate capacities in almost all areas of its workforce (NHP 2009; HSSP-III 2010) and continues to be underfunded (WHO, 2009) as well as suffering budget cuts.

For instance, according to the (HSSP-III 2010), Uganda's health sector is subjected to a considerable shortage of human resources in its

<sup>&</sup>lt;sup>3</sup> United Kingdom Health Informatics Society

workforce, whereby the doctor to patient ratio is at 1: 24,725. The deficit in the healthcare professional numbers has a negative impact on the quality of the health service delivery and patient care.

However, the impact of professional skill shortage is not only experienced in Uganda's health sector. In Kenya, the African Medical Research and Education Foundation (AMREF) instituted a programme in 2007, aimed at educating and training over 22,000 nurses via distance learning education by 2012 (IFC 2007).

Moving to the American continent, the Oregon Health & Science University initiated an online introductory programme as part of the American Medical Informatics Association's (AMIA) 10 x10 initiative to educate over 10,000 clinicians in medical informatics by the year 2010, if the United States had to meet its capacity demands for that period (Hersh and Williamson 2007).

At the same time, Canada needed between 1,500 and 2,000 personnel in the fields of Health informatics, Technologies and change management, if the Infoway<sup>4</sup> programme was to meet its set out goals and expectations (CHI 2006).

According to (Smith, Drake et al. 2011), one private hospital's Applied Medical Intelligence Research facility in Australia took 19 months in 2008 to fill three Informatics positions (Clinical Data Manager, Clinical Informatics System Manager, Clinical Data Analyst) with suitable staff, and similar delays in filling other health informatics positions have been reported in various healthcare settings.

The Uganda government has made efforts to provide education and training at various levels. However there is yet another problem, which is referred to as brain drain and which has had a remarkable impact on developing countries' capacity.

<sup>&</sup>lt;sup>4</sup> Infoway is an independent not-for-profit corporation created to foster and accelerate the development and adoption of EHR systems with compatible standards and communications technologies

According to (Urama, Ozor et al. 2010) at least one third of personnel, professionally educated in developing countries, live and work in developed counties. This is attributed to several factors, such as lack of funding in the educational sector, inadequate incentive for research and innovation, political instabilities, unfavourable livelihood among others motivations (Urama, Ozor et al. 2010). Professionals always migrate whenever their current living and working environment is not conducive or if they are not fairly rewarded for their contribution, a factor which has been acknowledged by the NHP (NHP 2009).

According to ATPS (2007), Uganda was among the top ten developing countries with a high rate of university graduates loss and these included professionals such as medical doctors, teachers, research scientists, etc. However, the remittances figure from Ugandans living and working abroad increased from US\$ 546 million in 2007/2008 to US\$ 748 million in 2008/2009 according to the national Economic Report of 2009.

The symposium organised by the African Technology Policy Studies Network (ATPS), held in Nairobi – Kenya in March 2010, came up with a temporary solution to the brain drain dilemma. Suggestions of borrowing the Federation of International Football Association (FIFA) model were made.

FIFA allows international footballers to return to play football games for their home countries at major (international) events. In the same way, scientists and all other professionals working abroad should be allowed and released on a temporary basis to return home and share their knowledge and skill set.

#### 2.5. Building Capacity in Health Informatics

Even though other business sectors had recognised the importance of education and training in informatics system design, development and implementation, according to (Norris and Brittain 2000), the health sector was reluctant or even resistant towards developing academic programmes intended for building health informatics capacity. Kushniruk et al (2006) as well as Hovenga (2004) suggested that one of the many challenges which have led to the failure of successful deployment and implementation of health informatics systems is the lack of having qualified health informaticians with the right mix of skills, knowledge and judgement, to ensure that they are capable of performing their required duties.

In the last 20 years, the number of Universities in Uganda has increased from two to over thirty public and private Universities, of which five offer programmes in Health Science, but none offers specialised programmes in Health Informatics (UNCHE 2011).

(Jaspers, Gardner et al. 2007) suggest that, some of the medical schools have not recognised the significance and importance of health informatics, and therefore not integrated into their traditional medical academic teaching curricula.

The health sector has recognised the need for having knowledgeable and skilled health informatics professionals who will manage and operate their healthcare informatics systems efficiently and effectively (IMIA 2000) and educational institutions have started to develop and offer academic programmes health informatics (Haux and Schmidt 2002).

#### 2.6. Health Informatics Curricula Evolution

Health informatics academic curricula have evolved over the past decades (Brittain and Norris 2000) due to advancements in science and technology (Haux 2010) as well as changes in the way healthcare services are conducted.

Health informatics programmes used to originate in the medical schools, medical research institutions, or the health sector academic facilities (Brittain and Norris 2000), but evidence now proves the contribution from other institutions and organisations such as the schools or colleges of computer and informatics science, such as the University of Dublin (TCD 2011), University College Limerick, (UCL 2011), University of Dar es Salaam (UDSM 2011), Centre for Health

Informatics (CHI), City University London (CHIME 2011), and more, towards the development these curricula.

Even though the objective of the health informatics curricula is aimed at the improvement of patient care and healthcare service delivery (Brittain and Norris 2000; Haux 2010) numerous debates are still ongoing, with regard to what should be included in the programme, as well as efforts to try and develop a generic framework of core subjects which must be covered in the programme (IMIA 2000).

Health informatics encompasses a wide spectrum of topics which are dependent on the desired knowledge and skills sets intended to be achieved. According to (Brittain and Norris 2000), the health informatics course design should always be based on the learner's intended outcomes, and from their experience as health informatics educators, they suggest that the programme should cover eight core competences, which include:

- 1) Communication skills and techniques
- 2) Data quality and management
- 3) Knowledge Management
- 4) Ethics, Privacy, Confidentiality and Security
- 5) Secondary use of clinical data and informatics systems
- 6) Working with Clinical Systems
- 7) Clinical and service audit
- 8) Telemedicine and Tele-care.

(Brittain and Norris 2000) went further and identified two groups of professionals who pursued career developments in health informatics education, and these used to be from either a Health Science or Informatics science background. However, (Hersh and Williamson 2007) identified a third group which covered healthcare professionals from a Management and social science background, who play a major
role in the running and operation of non-clinical services as described in the figure below:



Figure 2: Broad categories of competencies in biomedical and health informatics – adapted from Source: Hersh (2009) to highlight the third additional group identified by Hersh and Williamson

The First group was made up of professionals from the clinical or health science backgrounds, who have always been the potential candidates to pursue education in health informatics, since they had to bridge the gaps between healthcare specialists and informatics technologist. According to (Hersh and Williamson 2007), this is the group, which in charge of the optimisation of informatics system usage as well as the organisation and structuring of information for its primary and secondary usage.

The second group of professions were the Information Technologists working within the health sector, involved in the installation, maintenance, and configuration of the hardware and software. According to (Hersh, 2007), studies had shown that up to 40,000 new jobs were to be created in healthcare organisations in the area of advanced health informatics system implementation.

The third group of professions is comprised of Health Informatics Managers, who have skills and knowledge in electronic medical records, especially in areas of documentation, coding, and legal and compliance issues. (Dohm and Shniper 2007) highlighted in their paper that the present demand for Health Informatics Management Professional was over 170,000 and was expected to rise to over 200,000 by 2016.

#### 2.7. Health Informatics Curriculum Design

As mentioned earlier, debates are still in progress on the form and content of the health informatics curriculum at both under graduate and postgraduate levels. However, there is one organisation namely the International Medical Informatics Association (IMIA), which has made considerable efforts to redefine and transform the health informatics curriculum at an internal level.

IMIA is a vital organisation which represents the entire spectrum of health and biomedical informatics professionals around the world. It was initially established in 1969 by the International Federation for Information Processing (IFIP - www.ifip.org) as Technical Committee 4, under Swiss law, which later in 1989 transformed into IMIA (IMIA 2000; Mantas, Ammenwerth et al. 2010).

IMIA also has close ties with the World Health Organization (WHO www.who.int) and the International Federation of Health Records Organizations (IFHRO), and has membership ranging from academic institutions, national and international corporations, special interest and Working Groups from various countries around the globe (IMIA 2000; Murray 2008). All members contribute towards the development of IMIA strategic plans with their skill and knowledge of the digital age (Mantas, Ammenwerth et al. 2010).

#### 2.7.1. IMIA's Aims

- promote informatics in healthcare and research in health, bio and medical informatics
- 2) advance and nurture international cooperation
- 3) stimulate research, development and routine application

- move informatics from theory into practice in a full range of health delivery settings, from physician's office to acute and long term care
- 5) promote the dissemination and exchange of knowledge, informatics and technology
- 6) promote education and responsible behaviour
- represent the medical and health informatics field with the World Health Organization and other international professional and governmental organizations" (IMIA-Website 2011).

It hopes to achieve its aims by systematically connecting healthcare and non-healthcare people involved in health informatics world-wide, to develop, create, implement and incorporate intellectual knowledge required to improve healthcare using informatics as the enabling technology. This is hoped to be accomplished by bringing health workers, researchers, developers, consultants, vendors, service providers, suppliers and users together, to share the skills and knowledge required to support organisations through the technological transformation (Murray 2008).

# 2.7.2. IMIA's Vision

IMIA plays an import role in the implementation of science and informatics technology in the fields of healthcare and research in medical, health and bio-informatics worldwide (IMIA-WGC-2010 2009). Its vision is to have a unified healthcare system approach, where clinicians, researchers, patients and people in general will be supported by informatics tools, which will facilitate in the making of decisions and judgement in the right way at the right time (Murray 2008).

#### 2.8. IMIA's Health Informatics Academic Recommendations

The Working Group 1 and associate members of IMIA have made substantial efforts to design and develop academic curricula frameworks in health informatics. They have also made a number of recommendations on how the education and training programmes should be conducted and carried out and continue to evaluate and redesign the framework (IMIA 2000; IMIA-WG1 2007; IMIA-WGC-2010 2009; Mantas, Ammenwerth et al. 2010).

IMIA's educational recommendations are based on healthcare professionals' need to acquire skills and knowledge in processing health informatics and utilisation of informatics and communication technology.

These recommendations are regarded as a framework for national and international initiatives in health and medical informatics education, which supports and encourages students and teachers exchange on the international level as well as sharing of skills, resources and knowledge.

IMIA's educational recommendations framework states that:

"In order to provide good-quality healthcare, training and education in biomedical and health informatics", it is important that "various Healthcare professions, in different mode of Education, with Alternative types of specialisation, at various Levels of education which correspond to respective stages of career progression", which can be achieved by having "qualified Teachers to provide the course training which will lead to recognised qualifications for Health informatics positions".

Letter	Description
Η	Healthcare professional (e.g.: Clinicians, computer scientists,
	informaticians, researchers, etc.) should undertake training
	programmes in health and medical informatics.
E	Educational methodologies which are employed in providing
	the required training vary from the traditional classroom-
	based, Team-based, problem-based, distance and open

<b>T</b> 11			
Letter	Description		
	learning as well as exploration of other technologies such as		
	Video Conferencing, social networking platforms, etc.		
Α	Alternating routes to different types of specialisation will		
	depend on the health and medical informatics career path		
	chosen. Not all healthcare professional have to undertake		
	accredited specialisations (e.g. Masters or Doctoral levels) in		
	health and medical informatics. Some may desire to acquire		
	additional career development specialists' qualifications.		
L	Levels of Education: healthcare professionals will require		
	some sort of core knowledge in health and medical		
	informatics at different educational levels (e.g.: bachelors,		
	masters or Ph.D.) in order to fulfil the professional needs.		
	Therefore the educational levels required may vary in-terms		
	of depth and breadth, depending on the needs.		
Т	<i>Teachers</i> that conduct the training programmes must have		
	adequate knowledge and competence in the subjects that they		
	teach, in order to expect excellent outcomes.		
H	Health Informatics positions should be filled by qualified		
	health informaticians with internationally recognised		
	accredited qualifications in the health and medical informatics		
	domain.		
Table 3 <sup>.</sup>	Description of IMIA's Educational Framework - Adapted		

from (Mantas, Ammenwerth et al. 2010)

# 2.9. IMIA's Three Dimensional Framework

IMIA further describes its recommendations in a three dimensional framework, to roadmap the career path of healthcare professionals in Health Informatics. It identifies knowledge and skills to be acquired by healthcare professionals from various backgrounds, and matches them with the desired outcomes, including the attainable academic qualifications.

The three dimensions include professionals in healthcare, the type of specialisation and career stage: including Bachelor Degree, Master and PhD.



Figure 3: The three-dimensional educational career-path recommended by IMIA. Educational Recommendations for health informatics programme, highlighting the professional background and the career path (Mantas, Ammenwerth et al. 2010)

#### 2.10. Health Informatics Expected Outcomes

The health informatics academic curriculum is aimed at ensuring that graduates of the programme obtain a "holistic" view of health informatics systems and also have the ability to comprehend both the positive and negative impact of aspects such as ethical principles related to health informatics systems and society at large. Graduates are also expected to acquire broader knowledge on the main key aspects of the health sector in order to be able to design, develop, implement and evaluate end-user systems effectively and efficiently (Ammenwerth, Haux et al. 2003).

Apart from having the general intellectual academic skills of being able to practice and apply science adequately, handling information in a scientific manner, critically conducting scientific literature research studies and producing clearly written reports and collaborating multidisciplinary projects from their Master of Science degree programme (Jaspers, Gardner et al. 2007), graduates are expected to demonstrate specialist skills, attributes and knowledge.

The skills include the ability to identify, describe and analyse health related problems or situations, using the appropriate health terms and terminologies and then formulate or recommend appropriate solutions to implement, thereby bridging theoretical insight and practical application. Additional skills include making contributions to the design and development of solutions including processing and decision-making with insight in the field of health and medical informatics.

Attributes such as architectural reasoning, analytical and critical thinking are also expected from graduates.

Knowledge of significant processes connected with medical practice and care provision including prevention, diagnostics, prognosis and therapy is also required.

## 2.11. Health Informatics Curricula Content

All health informatics professionals require one or more specialised core competences in specific disciplines of health informatics, and they may also progress or advance in the same or other competencies throughout their careers (Hersh 2009).

(Norris and Brittain 2000) carried out another study, where they analysed 30 international health informatics programmes at postgraduate level. They used the information to incorporate the eight core competencies (highlighted in paragraph 2.6) to come up with four categories described in Table 4.

However, the American Health Informatics Management (AHIM) together with the American Medical Informatics Association (AMIA) used a different approach to identify healthcare professional's needs which resulted into their "10 x 10 Health Informatics Training programme"(AHIMA 2006; Hersh and Williamson 2007; AMIA-Web 2011).

AMIA<sup>5</sup> is a professional scientific association formed by the merger of three organizations in 1989: the American Association for Medical Systems and Informatics (AAMSI); the American College of Medical Informatics (ACMI); and the Symposium on Computer Applications in Medical Care (SCAMC).

Category	Sample Topics
Clinical and biomedical	<ul> <li>Clinical systems</li> <li>Bioinformatics</li> <li>Drinical system of all initial user division</li> </ul>
	<ul> <li>Principles of chinical medicine</li> <li>Physics and instrumentation of medical magnetic resonance</li> </ul>
	Introductory biostatistics
Information technology	• Databases and data structures
	Artificial intelligence
	Software engineering
	<ul> <li>Decision support systems</li> </ul>
	Advanced programming
Healthcare informatics	• Healthcare informatics and the
	management of information
	• Healthcare informatics: contracting,
	quality and performance
	Health knowledge management
	• The electronic health record
	• Ethics, security and medico legal issues
Health management	Healthcare economics
and policy	Project management
	• Organisational behaviour and
	management
	Health policy and information strategy

**Table 4:** Examples of topics in postgraduate healthcare informaticscourses – Source (Norris and Brittain 2000)

AMIA aims to lead the way in transforming healthcare through trusted science, education, and the practice of informatics. AMIA connects a broad community of more than 4,000 healthcare professionals (teachers and students interested in informatics, as well as thought-leaders on Bioinformatics) to bridge knowledge and collaboration across a continuum. AMIA actively supports the use of computers to investigate and process medical data.

<sup>&</sup>lt;sup>5</sup> http://www.amia.org/about-amia

In 2005, AMIA in collaboration with AHIM hosted a symposium in Washington DC aimed at various stakeholders from the healthcare industry, ranging from academia, professional associates, organisational providers, members of the business community, and government officials (AHIMA 2006).

The workshop addressed the present challenges facing the healthcare professional with regard to the Electronic Health Record (EHR) and the nationwide health informatics infrastructure.

Participants were then asked to develop recommendations on how they can ensure that healthcare professionals have sufficient knowledge and skills in information technology.

From the recommendations of the participants, AMIA developed a "10 x 10 health informatics training programme"<sup>6</sup>, which was later adapted by Oregon Health and Science University (OHSU) and included it as an introductory part to its traditional health informatics programme as an introductory module (Hersh and Williamson 2007). The introductory module is aimed at a wider audience of healthcare professionals including Health Informatics.

The module covers the development of the role and basic principles of ICT, how to implement usage in the medical field, fundamental functions including decision making and order entry systems, integrating records with assessment and information exchanges, interoperability and other challenges, principles of security and recourse as well as system users.

The course content for OHSU's introductory module, which evolved from AMIA's 10 x 10 Health Informatics programme, is illustrated in Appendix 5.

<sup>&</sup>lt;sup>6</sup> 10 x 10 represents the AMIA's programmes agenda of having to train up to 10,000 healthcare professionals in applied health and medical informatics by 2010.

After an extensive review of the design and content of health informatics academic programmes world-wide, the IMIA's Working Group 1 Committee (WG1C) came up with a number of recommendations for international practice (IMIA 2000; IMIA-WG1 2007; IMIA-WGC-2010 2009; Mantas, Ammenwerth et al. 2010).

These recommendations cater for the needs of various healthcare professionals, both clinical and non-clinical, as well as information technologists at various stages of their career progression as described in Appendix 4. The core competencies developed by WG1C encompasses a wide spectrum of health informatics knowledge and skill sets for both categories of the clinical and non-clinical professions, which have been broken down into four sub-divisions listed below:

- 1. Health Informatics Core knowledge and Skills
- 2. Informatics Science, Mathematics, Biometry
- 3. Medicine, Health and Biosciences, Health System Organisation
- 4. Optional Modules in health informatics and from Related Fields.

This framework sets out further recommendations for the participants' desired outcomes in-terms of skills and knowledge to be acquired, if they are to assume the roles of either Health Informatics users or health informatics specialists within the healthcare sector, including the recommended learning depth as describe in Figure 4 (also see Appendix 4: IMIA's Educational Recommendations).



Figure 4: IMIA's Educational Recommended topics with the knowledge and skills for healthcare professionals in either in their role as IT users or as Health Informatics specialists – Adapted from (Mantas, Ammenwerth et al. 2010)

#### 2.12. Health Informatics Recommended Workload

In order for a learner or student to successfully compete there education in Health Informatics at Master's Degree level, they have to complete a certain number of task, which includes attending of either face-to-face or virtual lecture, practical or laboratory exercises, assessments, workshops etc., under a specified duration and earn a certain amount of points designed for that specific programme. The points earned for the given programme are referred to as ECTS credit, which reflect the workload achieved by the learner.

ECTS<sup>7</sup> stands for "European Credit Transfer System", which is a tool that was designed for higher education as well as other lifelong learning activities in European countries. It was established in 1989 as a pilot scheme within a framework of Erasmus programme in order to facilitate the recognition of study periods undertaken abroad by mobile students (ECTS 2009).

ECTS is a learner-centred system for credit accumulation and transfer based on the transparency of standard learning processes and outcomes, and it is aims to facilitate planning, delivery, evaluation, recognition and validation of qualifications and units of learning as well as student mobility.

There are 60 ECTS<sup>8</sup> credits which is an equivalent of one full-time academic year at University level, which equates to about 1,500 to 1,800 hours. Therefore, one credit corresponds to 25 to 30 hours of learning activities such as Lectures, Workshops, practical, projects, assessments, presentations, reports and referred to as the workload (ECTS 2009).

For example, in the United Kingdom, the Framework for Qualifications of the European Higher Education Area (FQ-EHEA) identified a range

<sup>&</sup>lt;sup>7</sup> http://ec.europa.eu/education/lifelong-learning-policy/doc/ects/guide\_en.pdf

<sup>&</sup>lt;sup>8</sup> 1 academic year = 2 semester = 60 credits (1 semester = 30 credits and 1 term/trimester = 20) credits.

of ECTS credits typically associated with the completion of each cycle as follows:

- Bachelor's Degree between 180 240 ECTS credits
- Master's Degree between 60 120 (or 90 120) ECTS credits
- Doctoral Degree may have no credits associated with it.

However, workloads vary from country to country, institution to institution, as well as what the content and expectations of the designed programme (see Appendix 6).

For a Master's Degree programme in Health Informatics, IMIA recommends that the learner or student should earn a minimum of 60 ECTS credits in order to achieve a broad depth of the recommended core competence highlighted in Table 5 (see also Appendix 9) in period of not less than one year of full-time study (120 for two years).

IMIA's relative recommended amount of study-time which should cover the three main core competences at Master's Degree level are illustrated in table

Core Competences (Desired Skills and Knowledge)	ECTS (2 years)
Health Informatics core knowledge and skills	40 (80)
Health Informatics System organisation	10 (20)
Informatics/computer science, mathematics, biometry	10 (20)
Total Workload ECTS Credits	60 (120)

Table 5: Recommended student workload in ECTS credits for the three

skills and knowledge areas of the health informatics Master's

Degree programme as recommend by IMIA (Source:

(Mantas, Ammenwerth et al. 2010)

For instance, according to (Haux and Schmidt 2002), the University of Heidberg/Heilbronn's health informatics programmes runs for a period of one year between the month of October to July of the following year, and is made up of two semester.

In the first semester, students have a workload of 32 ECTS credits, 27 ECTS credits for the second semester, 10 ECTS credits for an inbetween session, and finally, 15 ECTS credits for the Master's thesis, making it a total of 84 ECTS credits for the entire programme, see Table 6 and Appendix 9.

Semester <sup>9</sup>	No. of Lectures	No. of Exercises	No. of Practical	No. of Seminars	ECTS Credits
Semester 1	19	1	3		32
Between 1 and 2			8		10
Semester 2	14	3		1	27
Pre-Master's Total	33	4	11	1	69
Master's Thesis					15
Total ECTS					84

**Table 6:** Illustration of the ECTS credits assigned to the programmeactivities at one of Heidelberg/ Heilbronn Health InformationManagement programme in Appendix 9 (Haux and Schmidt2002)

#### 2.13. Professional Development Pathway

(Brittain and Norris 2000) comment from their observations as educators in health informatics that most students prefer to study and obtain qualifications such as certificates, diplomas or degrees from renowned and well established academic institutions, rather than the new or internally developed awards within the health services sector, and they add that degrees are preferred to diplomas or certificates, although many choose the options which require less work.

In order to enrol in the Masters Degree programme, IMIA recommends that its prospective participants should have successfully completed either:

- Bachelor degree programme in health and medical informatics
- Bachelor or Master's Degree programme in medicine or health science related discipline, or
- Bachelors or Master's Degree in computer science.

For programmes leading to a doctoral degree, IMIA recommends that participants should have carried out a comprehensive research study

<sup>&</sup>lt;sup>9</sup> One Semester hour equals to 14 hours of class activities, held on a weekly basis

independently, in addition to the requirements previously mentioned at the Masters Degree level.

For programmes leading to a master or doctoral degree (e.g. Ph.D.), it is the comprehensive formal methodological foundation for health and medical informatics that predominates, at a formal level.

The objective of the Masters and Ph.D. degree programmes are to provide the participant with specialised theoretical scientific knowledge and practical skills in health informatics as well as providing them with the ability to independently participate in research and methodical advancement within the field of health and medical informatics (Mantas, Ammenwerth et al. 2010).

(Mantas, Ammenwerth et al. 2010) note how at present, there are several opportunities to obtain health and medical informatics education worldwide, although curriculum structures and career paths may vary from country to country, based on the localised needs. It should also however be noted that, there are still many countries which have not sufficiently established such training opportunities in the Health Informatics domain, such as Sudan, Uganda, Kenya and the Democratic Republic of Congo.

# 2.14. Collaboration at institutional level

Collaborations at institutional level (i.e. collaboration of academic institutions with other institutions beyond geographical boundaries) is said to have a number of potential benefits to both students and teachers.

For example, the international partnership in health informatics education (I $\Phi$ E) was established in 1998, was aimed at improving the quality of the health informatics educational programmes, as well as promoting international student and teacher collaboration among its patterned institutions and sharing of resources and knowledge (Leven, Knaup et al. 2004).

According to (Leven, Knaup et al. 2004; Jaspers, Gardner et al. 2007), the IΦE hold six memberships from institutions such as the University of Amsterdam (Netherlands)(Kulikowski, Ammenwerth et al. 2002), the Universities of Heidelberg and Heilbronn (Germany)(Leven and Haux 1998), and three Universities from the United States of America, the University of Minnesota (UNM 2011), University of Utah (Utah 2011) and the University of Washington - Seattle.



**Figure 5:** IΦE partnership Universities and programmes offered –

Source (Leven, Knaup et al. 2004)

Some of the activities conducted by  $I\Phi E$  include the running of the health informatics master classes, workshops as well as students and teacher exchange programmes from the signatory members.

For example, three European universities which include the University of Amsterdam, Heidelberg/Heilbronn - Germany, and Tyrol – Austria, in collaboration with the University of Utah and Minnesota run health informatics programmes both at under graduate and post-graduate levels between the five universities (Ammenwerth, Haux et al. 2003). They believed that internationalisation of their educational programmes should no longer be a by-product of an external funding policy, but rather constitute as an integral part of their higher education activities.

# 2.15. Abridgment

Health Informatics, however the various interchangeable terminology and definitions, infer the "how" and "what" components of data and knowledge, in the health sector, in order to facilitate and translate value, both to professionals working in the sector and to the patients under their care.

The intersection of information can extend to speciality fields such as genomics or biosciences to process complex levels of data such as DNA and intercellular processes.

The discipline is more than just an awareness of skills and attributes but rather knowledge that continues to be developed and pursued by academicians as well as health professionals and research communities.

Health Informatics can be said to be driven by the demand of basic economics to deliver more where better care can cost less.

The availability of education and technology is at the heart of building capacity as is maintaining the skill set domestically.

Recognising the need for Health Informatics alone is not enough to launch a successful academic strategy to research and establish capacity.

ICT and Health professionals need a platform to harness the opportunity where each can derive and share benefits in an integrated approach.

By harnessing established criteria and expertise from an international institution such as the IMIA, academic institutions endeavouring to establish an academic course and/or augment existing course offers, can align themselves in partnership to ensure it does not have to reinvent itself, but rather build on researched and tried frameworks, including curricula, which can be tailored to meet local infrastructure and skill levels.

Partnership on an international level benefit the health sector and students as collaboration ensures standards are maintained and that development and advancement in the field are shared.

#### 2.16. Summary

This chapter examined what Health Informatics is and the role it plays in the health sector for both developed and developing countries. Various challenges facing Health Informatics capacity and means of overcoming these challenges were scrutinised, which led to the assessment of Health Informatics training and research curriculum designs. The study then explored how the present Health Informatics curricula is designed and if there was an international framework for design and content, which could be used as a foundation of tried and tested measures to build on when designing and implementing the same for Uganda. An international framework could be used to lead process of design, implementation, content, duration as well as awards.

Of these, the most important aspect considered critical to success, has been found to be the recommended and fundamental core competencies that a prospective student should have knowledge of. The educational recommendations made by the International Medical Informatics Association were analysed in great detail, including the recommended skills and knowledge, academic workloads and career paths. The chapter ended by looking at the benefits of forming collaborations with other academic or clinical institutions.

# CHAPTER 3

# **RESEARCH METHODOLOGY**

# **3.** Methodology

# 3.1. Problem Statement

The main objective of the study was to explore how Uganda could build capacity in Health Informatics, through teaching and research, in an attempt to improve the efficiency and effectiveness of the healthcare services delivery and patient care.

Qualitative research refers to research methodologies that help us understand what the world or reality means to us by adopting and utilising certain perspectives (Kyung Rim, Mi Young et al. 2009), through the use of various investigatory techniques such as interviews, documentations and reports. Qualitative research can also be described as a broad approach to understand more about human perspectives and provide a detailed description of a given event or phenomenon (Creswell 2007). (Leydens, Moskal et al. 2004).

The study employed the "Qualitative Research" methodology, with a combination of techniques such as literature review, structured interviews, observation (through workshops) and other relevant documentation reviews to ensure that the goals and objective were achieved from the information and knowledge uncovered by the study.

# 3.2. Literature review

According to (Kumar 2005), literature review provides the theoretical background of the study and also assists the research to contextualise their finding by comparing them with those which have already been uncovered.

The literature review is aimed at steering the research towards the goals and objectives of the study. In addition to providing clarity to the problem being investigated and broadening the researcher's knowledge, it also improves the research method feasibility in context of being able to focus the approach in respect of formality and structure(Kumar 2005). Therefore, the study began with the review of documentation such as the Uganda's current National Development plan, the Health Sector's strategic plans and ICT policies which were provided by the Information Resource Centre for Uganda's Ministry of Health, and some of the documents which were reviewed included copies of the NDP, MDGs, HSSP, HSICTP, NICTP, eHealth workshops, Health Informatics systems workshops, reports on challenges in implementing health informatics systems in Uganda, etc (HSICTP 2006; NHP 2009; Vision-2012 2009; HSSP-III 2010; MGD-Report 2010; NDP-2015 2010) (glossary of these documents is on appendix 8).

Furthermore, an enquiry strategy to search for published literature in the health informatics domain was launched, where keywords such as, *Health Informatics teaching and research, Evaluation of Health Informatics training programmes, Health Informatics in developing countries, Masters of Science in Health Informatics, Health Informatics curriculum design*, were queried from various online databases such as *PubMed, Science Direct, Absco, as well as Google Scholar.* 

Access to information for the literature review was limited to the English language, however, taking into account that it was gathered from leading and cross continent sources including Europe, the United States, Canada and Australia, was deemed adequate to fulfil the requirements of the study.

Subjects which were included in the literature review focussed on the role of Health Informatics in the health sector and the challenges it presents; experience and strategic direction of health and academic institutions in developing or building capacity in health informatics, through teaching and research; Health Informatics curriculum design and recommended syllabus from the experts; Career pathways and the benefits of collaborations of academic institutions in the building of Health Informatics capacity.

#### 3.3. Interview Process

Therefore, (Maxwell 2005) suggest that the research should explicitly state the "goal(s)" of the study and how it is going to be conducted, followed by the "conceptual framework" of the problem, through the review of literature and other investigatory techniques. It is then at that point, when the research has to formulate "research questions" to answer the "unknown concept" which requires understanding through the form of interviews.

Through the literature review, the study had to identify the role of Health Informatics and the benefits it contributes to the health sector, both in developed and still developing countries, as well as the challenges that are surrounding Health Informatics capacity. The study also explored means of how to build capacity in Health Informatics through teaching and research, where the main focus was aimed at the formulation and design of Health Informatics academic curricula.

(Leydens, Moskal et al. 2004) noted that Interviews provide a mechanism in which data which is less obvious can be captured through assessing the participants' thoughts and perceptions, which can confirm, contradict, complicate, or complement observational data.

The study utilised a combination of structured and semi-structured interview techniques, which (Ghauri and Grønhaug 2005; Easterby-Smith, Thorpe et al. 2008) suggested enables the researcher to conduct in-depth formal interview(s) based on a question formulated from the conceptual framework of the study.

However, due to time constraints, the study limited itself to four structured interviews of which two were conducted in Ireland and two in Uganda. Several unstructured interviews from professionals in the field of healthcare, health informatics administration and academic experts were conducted using research methods including surveys, questionnaires and telephonic interviews.

Principle stakeholders were identified and prioritised for face-to-face interviews, formally structured for a case study approach whereas

secondary stakeholders were earmarked for more informal and unstructured approaches.

Nine academic institutions which offer Health Informatics training programmes were contacted by means of a pre-drafted electronic mail (email), which contained a survey and questions pertaining to specifics in regards to Health Informatics. In total, four were from Ireland, three from Africa, as well as one each from Canada and the Netherlands. Two of the four institutions which were contacted from Ireland declined the requests, There was no response from the African or the Canadian institutions despite numerous attempts. The date proposed by the institution in the Netherlands was unsuitable and therefore the interview not carried out.

Due to the limited number of responses received from the electronic email exercise, the study sourced information from literature published online (website) by institutions which actively participate in building capacity for Health Informatics (CHIME 2011; TCD 2011; UDSM 2011; UH-MI 2011; UNM 2011; Utah 2011).

The findings from the interviews are documented in the research findings section of this report, and as well as the background information of the establishments interviewed.

#### **3.4.** Observations Made

During the research visit to Uganda, an opportunity presented itself to attend a workshop on "Healthcare Data Use". The workshop was organised by Uganda Ministry of Health in collaboration with The Centre of Disease Control and the United States President's Aid Programme, and was aimed at bringing together all health informatics stakeholders around the country to meet, share and discuss various aspects associated to the management of health informatics data.

Attendance at this workshop was vital to the study, as it provided an insight and understanding of the challenges faced in respect of resources, skills, infrastructure, funding, visions and policy of government versus private sectors as well as the critical need to improve patient care. The summary of this workshop which took place on the 14th - 16th of June 2011 are highlighted in APPENDIX 13 and are also discussed in the research findings section.

## 3.5. Target Group

The study targeted participants from the academic professional backgrounds, fulfilling roles of either senior lectureship, head of school/ department/ faculty and other appointed persons involved in the Health Informatics domain, senior clinical offers, health informatics managers and health informaticians.

Students currently enrolled in Health Informatics were not included in the research. However, the focus of future research into the framework structure and content of the curriculum, to ensure alignment and cohesion between the Health and ICT sectors, would benefit if students were included as primary stakeholders.

#### 3.6. Data Collection and Analysis

Qualitative research is known to yield fewer cases but has the primary advantage of yielding credible and purposeful sampling (Leydens, Moskal et al. 2004).

This was particularly important to the research as the study required detailed information in light of the end objective being to submit recommendations to Uganda.

Qualitative data was collected through the structured interviews from two institutions in Ireland which are involved in Health Informatics teaching and research, one with the Ministry of Health in Uganda, two with Makerere University School of Computing and Informatics Science and the last interview was with the Chief Informatics Officer of the Centre of Disease Control.

The data was transcribed, coded and processed, based on the research aims and objectives. Additional contributions made by secondary participants, who were not part of the formal interview structure, were also included and coded as these provided additional variants to support the study. These are included in the research finding and recommendation sections.

## **3.7.** Research Ethics

The research did not have interaction or dealings with private and confidential personal information. In addition, minors were not included or involved during any stage of the study. As such, the study prioritised giving recognition to and quoting sources of information and did not request ethical approval from any of the University's Research Ethics Committee.

All those who participated in the structured, semi-structured and unstructured interviews received a clear explanation of the purpose and intent of the interviews or conversations and they freely consented to offer their knowledge, views, opinions and expertise which was considered to be critical and vital for the study, without being forced, deluded or promised any incentives and gain from their contributions.

Although the participants' anonymity was maintained, all the information shared was neither confidential nor in breach of any regulations.

#### **3.8.** Research Outcomes

The expected outcome from the study was to recommend to Uganda, based on researched evidence, how they can go about the process of establishing a centre for teaching and research in Health Informatics, including recommendations pertaining to critical factors to ensure the success and sustainability of such a venture based on national and international support, affiliations, accreditation, nominated institutions and curriculum.

#### 3.9. Summary

This chapter discussed the research methodology selected for the study and highlighted the benefit of a qualitative approach, which yield fewer but purposeful sampling to provide meaningful criteria. The study contextualised the information from the literature, varying its approach for different audiences. This enabled the study to firstly gain knowledge of and an understanding of health informatics before comparing information uncovered during the research. A combination of investigative techniques such as structured and semi-structured interviews, observations and surveys were used.

The study did not compare information pertaining the government, health service and academic structures in Uganda. The study aimed to gather information on these structures to align its recommendations for a best fit to ensure infrastructure and resources as well as capability to support a Health Informatics training and research centre and literature.

# CHAPTER 4 RESEARCH FINDINGS

#### 4. FINDINGS

#### 4.1. Introduction

The research needed to gain a clear understanding of Health Informatics and familiarise itself with industry standards and requirements before attempting to involve potential participants in Uganda. The research conducted a literature review in order to gain understanding and then embarked on a study to contextualise the findings through comparisons. Formal interviews were structured for case studies with local organisations whereas other audiences were targeted with less formal but structured questions.

A total of four structured interviews were conducted, two from third level academic institutions in Ireland, hereinafter coded as HIR1<sup>10</sup> and HIR2<sup>11</sup> respectively, and a further two in Uganda, the first of which was with the Ministry of Health and the second, with the School of Computing and Information Science in Makerere University, hereinafter coded as HSR1 and MUKR1.

Below is the brief background of the Irish institutions which were interviewed by the study.

- HIR1 is a Health Informatics education and research centre of a renowned third level institution in Ireland, which was established in 2000, with the aim to develop and promote the discipline of Health Informatics within the school of medicine and health science through teaching.
- HIR1's Health Informatics curriculum was designed to cater for students who wish to pursue the programme at Certificate, Diploma or Master's Degree level as described in Table 7.

<sup>&</sup>lt;sup>10</sup> HIR1 – Identifies the Health Informatics Respondent 1 who participated in the structured interviews conducted by the study.

 $<sup>^{11}\,\</sup>rm HIR2$  – Identifies the Health Informatics Respondent 2 who participated in the structured interviews conducted by the study

Qualification	Expected Modules	ECTS Credits	Duration
Certificate	3	10	1 Semester
Higher Diploma	6	60	2 Semester
Master Degree	8	120	4 Semester

**Table 7:** Sample Outline of Programme Qualification, Number of<br/>modules covered, Course workload and Duration (Adapted<br/>from HIR1's Information provided during the interview)

The Health Informatics programme conducted at HIR1 is aimed at healthcare professionals who have an interest in Evidence Based Medicine and Health Informatics Research. The programme includes professionals such as Clinical Doctors, General Practitioners, Consultants, Nurses, Physiotherapists and Speech and Language therapists.

HIR2 is a third level academic institution in Ireland, who offer education and research training to students from a healthcare professional background, such as Health Care Administrator/Clerical Officer, Health Care Manager, Clinicians, or Health Care Professional who hold a primary undergraduate degree in one of the health science disciplines.

HIR2's academic programme comprises of two taught semesters, and in the final part of semester (running into the summer break), students are required to complete a substantial dissertation as described in Table 8.

Taught Semester 1	<ul> <li>Health Informatics Applications</li> <li>Electronic Health Record Management</li> <li>Research Methods in Health Informatics</li> <li>Medical Decision Support Systems</li> <li>Requirements Engineering for Health Informatics</li> </ul>
Taught Semester 2	<ul> <li>Healthcare Informatics Systems Development</li> <li>Health Informatics Project Management</li> <li>Strategic Issues in Health Informatics</li> <li>E-Health Systems</li> <li>ICT for Evidence-Based Healthcare</li> </ul>
Final part of Semester 2 (Last till end of Summer)	Final Dissertation

**Table 8:** Module Samples programme offered at HIR2 (Information captured and adapted from HIR2's Website)

Students at HIR2 attend 5 in-house sessions made up of two days, a Friday and Saturday for the taught semester and 50% of the programme is conducted via distance learning, which is another added advantage for those learners who are in full time employment.

Distance learning gives learners the flexibility to continue with their working routines whilst pursuing further studies. In the event that learners are able to take time off to attend lectures, the ten days can be taken as part of their annual leave entitlement (HIR2).

The study concluded that although both institutions offered third level education, HIR1 have collaborated internationally and drive the need for formally qualified Health Informaticians to elicit value from information whereas HIR2, offer auxiliary qualifications that support persons to manage information.

The study contextualised the information obtained through the literature review and was able to make comparisons. It concluded that offering of a career path with rewards, recognition, progression and flexibility at different entry levels would drive Health Informatics to international standards and ultimately deliver cost savings, time and improved patient care.

# 4.2. Assessment of Uganda's Health Information Needs

Since the research was aimed at investigating prospects of building capacity in Health Informatics in Uganda, this section accounts for the outcomes from the field study conducted in Uganda. The field study was aimed at:

- Assessing the Health Sector's major information need and the status of health informatics in order to determine the content of the curriculum design
- Assessing the need for health informatics training and investigating if there are any programmes offered at present in order to avoid duplication

- Identifying key stakeholders and assessing how they could be involved in the establishment, development, implementation and operation of the health informatics centre
- Assessing the existing academic infrastructure and establishing if it can used to support sustain the programme for building capacity in Health Informatics.

In the interview conducted with the Ministry of Health in Uganda, the study asked HSR112 to briefly address the current health informatics needs.

HSR1 directed the study to specific government documents in order to access and assess the necessary information which was deemed to vital to the study. These documents included the National Development Plans, Health Sector ICT Strategies and Policies, National ICT Policies, Health Informatics convention reports and references to the Ministry of Health's Website.

HSR1 informed the study that at present, the Health Informatics data collection and management faces numerous challenges, some of which were also addressed in Strategic Framework Vision 2012 (Vision, 2012):

- There is a great deal of duplication in the data sets collected since data managers are all using different programs to capture the same type of data, even at the same service points
- 2) Existing systems which have been developed are fragmented and are not scalable
- 3) The architectural design of some of the existing systems do not support or serve the intended user's needs, making it impossible to even use the data after the point of capture
- 4) Infrastructure remains the biggest challenge. Various locations and the service points within each location, have different data

<sup>&</sup>lt;sup>12</sup> HSR1 (Health Sector Respondent 1) – Interviewed respondent from the Ministry of Health

management systems in use. Some are manual whereas others comprise of a mixture of legacy or NGO sponsored systems which are all different and may either be sponsored or inherited, which then results to interoperable issues.

When asked what types of challenges are experienced with the existing Health Informatics systems, HSR1 responded:

- That some of the data capturing tools are so complex that data managers and users are unable to use or operate them
- That the systems do not harmonize with data collection tools to avoid redundancies and duplication of efforts
- There is a need for an inbuilt flexibility that allow integration of emerging data needs of data users and scaling up of the system
- 4) That systems and process in place and working well, albeit few, should be incorporated and expanded rather than discarding everything and starting from scratch
- 5) That ICT innovation should be used for enhancing performance, effectiveness and efficiency. Therefore the system tools should be interoperable, scalable and easy to use by all professionals, including frontline health workers.

HSR1 continued by expressing the need for raising awareness about the benefits of health informatics in the health sector and stressed that it was essential:

- To define best practice of integrating and implementing relevant technological innovations and find means of getting all healthcare professionals involved in the transformation of health informatics systems
- 2) To harmonise existing fragmented information systems and transform them into interactive modules
- 3) To disseminate health informatics to the relevant audience in a user-friendly format and allow for users at all entry levels including those with no computer literacy

- To identify and define how the health sector could enhance the development of the National Health Informatics system infrastructure
- 5) To identify and define the roles for the Health Ministry, Academic Institutions, NGOs and other stakeholders in providing leadership and promoting health informatics across the health and academic sector
- 6) To formulate and integrate a clear strategy to foster and sustain investment in the National Health Informatics programme.

The interview ended with the following comments from the respondent; "There is a pressing need to build capacity in Health informatics, if the health sector is to successfully implement information technology, and also transform the way it manages its health informatics systems. There is a need to establish a Health Informatics Centre of Excellence which will be used for teaching and research purposes. There is a need to establish a health informatics association, which will play the role for governing and overlooking all health informatics related activities. There is a need to source for financiers and investors in order to sustain these developments. Health Informatics has to be pushed forward on the government's and health sector's strategic development agenda. Several talks have been ongoing in relation to these issues, but it is time to turn the conversations into action".

In order to assess the health sector's informatics needs, the research requested and obtained permission to attend a conference between the 14 and 16 of June 2011, hosted by the Ministry of Health for the third consecutive year on "Health Informatics Data Use".

The conference was originally setup in 2009, by the Centre of Disease Control (CDC-Atlanta) in collaboration with the Ministry of Health Informatics Resource Centre and other international Partners. The event was aimed at bringing together health informatics stakeholders nationally, to meet, share and discuss various aspects associated with the management of health informatics data.

Participants got the opportunity to share with their peers the progress made towards building health informatics systems from their areas of operation including the challenges encountered in the process. They also heard from experienced professional key speakers operating in the health informatics discipline, who shared their knowledge and experience of health information management.

In the bid to gain further understating of the present health information needs of Uganda's Health Sector, the study reviewed a report on the eHealth Stakeholders' Consultative Workshop which took place in Kampala on 2 - 4 June 2011 (SCW, 2011).

Participants who attended the symposium had to break into group session as part of the programme to participate in debates and discussions related to eHealth.

According to the SCW (2011) published report, one of the group sessions which was involved in the "*Informatics and Innovations*" discussion highlighted a number of important issues which are closely related to this study, in terms of assessing information needs.

Deliberation from this group session "*Informatics and Innovations*", summarised in **Table 9**, share comparable similarities with the recommendations made by Brittain and Norris (2000) in section 2.11 as well as AMIA's 10 x 10 educational programme in APPENDIX 5.

Telemedicine/Telehealth:	Electronic Health Records:
Minimum hardware specifications	• Privacy & security
should be given.	Patient access to records
Need for Telemedicine	• Ethics/law on utilization
infrastructure (equipment	• Unique patient identifiers
compatible within the network).	• Compatibility with existing
• Need for Technicians to operate,	data (national ID, medical
maintain & repair equipment.	insurance, data exchange
• Need Transmission security.	with other medical systems).
• Need Ethics (consent,	Agreed patient/client
confidentiality).	variables to be included in
• Develop communication standards-	records.

<ul> <li>bandwidth specifications.</li> <li>Coverage (private, public, facility level)</li> <li>Cost effectiveness &amp; sustainability</li> </ul>	<ul> <li>Standard coding of diseases &amp; medication</li> <li>Specify cadres to operate &amp; analyze data.</li> </ul>		
<ul> <li>HMIS:</li> <li>Need for Standard codes &amp; indicators.</li> <li>Standard reporting tools need to be improved.</li> <li>Web enabled information systems</li> <li>Regulate Access rights</li> <li>Have appropriate cadres for data management</li> <li>Provide Regular feedback to data sources</li> <li>Backups in order to minimize data losses.</li> <li>Data violation checks should be made.</li> <li>Specific reporting channels should be highlighted.</li> <li>National data warehouse is required</li> </ul>	<ul> <li>Mobile Health:</li> <li>Device consistency (information should not be altered)</li> <li>Security- use of pin codes</li> <li>Transmission confirmation when data is received at the receiving end.</li> <li>Minimum hardware specifications should be provided always.</li> <li>Health education for users &amp; general population</li> <li>Standards of coding &amp; interoperability</li> </ul>		
• Consider other programs with electronic data systems like IDCAP			
Data Formats: video, images:			
Standard formats/interoperability Accuracy- entry validation checks security should be maintained. Minimum database specifications should be made and observed.			

• Software flexibility to allow changes and innovations.

**Table 9:** Summary if Information and Innovation issues discussed at

(Data-Use 2010) which could be used as reference guide to

the academic curriculum design.

Other topics of interest with regards to the needs for health informatics discussed at the *"Information and Innovation"* group session included:

- Diagnostics Digital BP machines, digital stethoscopes, digital ultra sounds innovations
- Consideration of open source, proprietary software and in-house developed applications
- Interoperability standards and conformity
- Leverage new technologies to our advantage (e.g. artificial data warehousing)

- Adoption of Grid and Cloud computing technologies
- Security, privacy and confidentiality, etc.

Another group session which was debating on issues related to "*Investment and Infrastructure*" raised a few more interesting ideas which are also of direct relevance to this study, which further justifies the need for establishing a health informatics training centre. Topics which were discussed included:

- The need for building capacity which will sustain the eHealth strategy
- Establishing a centre of excellence, which could be located in either an academic or operation area (i.e. Makerere University School of Public Health, in teaching or district hospitals or even within the Ministry of Health Resource Centre)
- The Centre of Excellence could also be an innovations site and a site for testing software for local operability
- Inclusion of the Institute of Communication and Technology which offers training in ICTs including Computer Engineering as a key player and stakeholder in eHealth.

Appendix 13consists of "Situation Analysis" summaries from three health informatics conventions held by the Information Resource Centre for Uganda's Ministry of Health in collaboration with other local and international partners.

They present background information of the present health information needs of Uganda as well as the challenges being faced by the sector with regards to information technology, information management and limited skilled human resources.

The study then made a summary of the urgent information needs after observing the proceedings of the Health Data Use workshop, which took place 0n 14 -16 of July 2011, and these included the need to:
- Develop polices and guidelines which will be utilised by healthcare informatics managers (including public, private and international partners) on how to capture and manage health informatics
- Develop training programmes for National, Regional, District and other healthcare facilities stakeholders on best policies and practices of dealing with health informatics data
- Develop strategies which will strengthen the monitoring, reporting and evaluation of information gathering and production programmes
- Come up with appropriate and sustainable health informatics systems infrastructure, and also raise awareness of the benefits for using them
- Find ways and means of harmonising Uganda's heavily fragmented health informatics system which could lead to the weakening of the National Health Informatics System
- Uncover means of how to get all healthcare professionals involved in the transformation of health informatics systems
- Examine how necessary technological innovations can internally be implemented with the vision of scalability
- Analyse information will be disseminated to the target audience in a user-friendly format.

#### 4.3. Stakeholder Identification Process

There are various stakeholders who the study identified as key players in the initiation and implementation of the objective of this research, which is to build capacity in Health informatics.

According to the reviewed literature recorded in the report so far, Health Informatics is about facilitating various forms of communication amongst all key stakeholders, which include; Clinicians, Healthcare administrators, Medical specialists, Information Specialists, Students, Educationalist, and all those involved in the domain of healthcare informatics management.

During the literature review, the study focussed on obtaining clear reference and instruction on the design and implementation of a health informatics curriculum. However, the interviews revealed the critical need of identification of all the potential stakeholders.

HIR1 discussed the difficulty of identifying and getting potential and influential stakeholders on board, by convincing them of the importance of health informatics and engaging them in communication and negotiation dialogue.

HIR1 advised that the identification of key stakeholders and possible third parties was crucial before engaging in negotiations. Once negotiation commences, HIR1 recommends continuous update of the current status and progress of the project in order to convince them of the future potential benefits the programme has to offer in the interest of the general public and the services provided by healthcare.

Enhancing the communication strategic channels, between all major stakeholders is crucial for the success of the project. It is thus paramount that the person selected to drive the project possess first class communication and interpersonal skills as well as the ability to champion and drive change.

The study identified the first category of stakeholders as the Uganda's Ministry of Health (MoH). The Ministry of Health has the mandate to ensure that the people of Uganda attain a healthy and productive life and is also responsible for providing the appropriate capacity which will sustain the health information systems and infrastructure (HSICTP 2006; NHP 2009; Vision-2012 2009; HSSP-III 2010; NDP-2015 2010).

Therefore, the study recognised the MoH as one of the Major stakeholders and the particular section identified is the Resource and Information Centre of the Ministry of Health, which is in charge of all the health sector's information needs and programmes(HSICTP 2006; NHP 2009; Vision-2012 2009).

The second category identified was also from the MoH, and this includes all healthcare professionals who will be enrolling in the Health Informatics Programme as students. This group will consist of primarily healthcare professional such as Doctors, GP, Nurses, Laboratory technicians, etc, as highlighted in section 2.6 in Figure 2, (Hersh 2009) and also suggested by HIR1 and HIR2.

The third category was from the academia workforce, who will participate in the design of the academic curriculum and deliver the education to the prospective student. The study initially identified Makerere University as the prime and suitable location to host the Health Informatics teaching and research centre, due to the reasons already presented in the Motivation and Justification section of this report.

However, the study identified a further two colleges from within the structure of Makerere University, which could be actively involved in the project initiation and operation, in conjunction with the MoH.

The two colleges identified were the College of Health Science (CHS)(CHS-Web 2011), since it is engaged in the education and training of all health science students and it has close connections with the MoH. and the College of Computing and Information Science (COCIS) (COCIS-Web 2011), which has the capacity offer the information and technology teaching component, and has also been facilitating the supervision of undergraduate and postgraduate research project for students from CHS (MUKR1)<sup>13</sup>.

CHS comprises of four schools, namely the School of Medicine, the School of Public Health, the School of Biomedicine and the School of Health Science, while COCIS is made-up of the School Computing and

<sup>&</sup>lt;sup>13</sup> Information acquired during the Interview process at Makerere University's School of Computing and Informatics

Informatics Science and the East African School of Library and Information Science APPENDIX 10 and APPENDIX 11.

The fourth category comprises of international research and academic partners. This includes organisations, which are involved in medical research at various levels and collect a substantial amount of health information. Some of the international research partners include organisations such as the Centre of Disease Control<sup>14</sup>, the Canadian International Development Agency<sup>15</sup>, the United States Relief AID Programme, and the Norwegian Agency for Development<sup>16</sup>.

The same category is also made up of third level institutions academic research partners, who are either involved in clinical research with the Ministry of Health or with the College of Health Science in Makerere University. Such academic partners include institutions such as Case Western Reserve University, Johns Hopkins University, University of California in San Francisco, Columbia University and the University of Medicine & Dentistry of New Jersey, Institute of Epidemiology and Social Medicine, University of Aarhus, Denmark, International Health Care Research (IHCAR), Karolinska Institute, Sweden among others<sup>17</sup>.

The last category of stakeholder identified by the study, were the Government agencies, at ministerial level, other than the Ministry of Health. This category includes the Ministry of Local Government, Ministry of Finance, Planning and Economic Development, Ministry of Education and Sports (MoES), Ministry of Information Technology and Communication among other(Vision-2012 2009; HSSP-III 2010; NDP-2015 2010).

HIR1 however stressed the importance of "Getting the key decision makers on your side, who are willing and committed to carrying out the required tasks which will contribute to the success of the project" and further suggested that, "based on experience, there is a need to

<sup>&</sup>lt;sup>14</sup> http://www.cdc.gov/ 13/09/11

<sup>&</sup>lt;sup>15</sup> http://www.acdi-cida.gc.ca/ 13/09/11

<sup>&</sup>lt;sup>16</sup> http://www.norad.no/en/ 13/09/11

<sup>&</sup>lt;sup>17</sup> http://www.muwrp.org/?page\_id=183 and http://www.chdc.mak.ac.ug/collaborations.html 13/09/11

continuously raise awareness of health informatics to existing as well as other prospective stakeholders.

HIR1 further suggested that during the curriculum design process, at a minimum, the team has to comprise of Educationalists, Health Informaticians, Healthcare professionals, Information Technologists, Medical Scientists, Computer Scientists, and Students.

HIR1 and HIR2 validated the need for collaboration, especially with the Healthcare Service Executives, Health Informatics related organisations and other institutions to review and make recommendations on the proposed programme.

#### 4.4. Curriculum Design

There are several aspects to consider before developing any academic programme. These include the intended target audience of the curriculum, the educational needs and training level of the participants, the expected outcomes as well as the design of the programme.

According to Norris and Brittain (2000), the health informatics programme should be based on the current requirements incorporating envisaged and/or predicted needs of the health sector. These requirements should be merged with the desired outcome for students.

HIR1 advised the study that the curriculum design should be based on the health sector's needs, in order to serve its present and future needs as well as being aimed towards the improvement of patient care and service delivery, which HIR1 referred to as "fulfilment of society needs"

HIR1 further recommended that educational curriculum design should start with defining programme objectives, followed by the definition of expected outcomes. However as mentioned earlier, assessment of the student level of training and knowledge forms the crucial starting point.

HIR1 in agreement with HIR2 stressed the importance of involving the key stakeholders in the design process of the academic curriculum. For example, the University of Victoria in Canada recognised the importance of involving all major stakeholders while designing its Masters programme in health informatics. This included members of the health service, Informatics Instructors and Tutors, funding agencies, past and present learners, etc, who assisted in identifying some of the required needs and topics(Lau 2007).

#### 4.4.1. Programme Goals and Objectives

The study asked HIR1 to give a brief account of what was the motivation behind setting up a Health Informatics teaching and research programme. The study was referred to the statement made by the Association of American Medical Colleges (AAMC), and this statement forms and sets the goals and objectives on which their programme is based.

It states that, "To support healthcare, life-long learning, education, research and management medical students should be able to at the time of graduation to utilise biomedical and psychosocial information for: formulating problems; arriving at solution strategies; collecting and critiquing and analysing information; taking appropriate action based on findings and communicating/documenting these processes and results".

HIR1 added that the objectives for setting up a health informatics training programmes as well as the curriculum should be *"tangible, valuable* and *measurable"*. The goals should be realistic and achievable and in addition, the programme should be established in a manner that ensures sustainability of standards and needs.

# 4.4.2. Expectation from Health Informatics Programme

The study asked how the respondents formulated the expected out comes for their Health Informatics academic curriculum and HIR1 responded by stating that "the curriculum design process begins with outlining the expected outcomes of the programme as well as what the students hope to achieve at the end of the programme. HIR1 further added that it was necessary to first of all establish the current level of knowledge of prospective participants before developing the academic programme in order not to duplicate knowledge or eliminate vital components of health informatics on the assumption that they are known facts.

On the other hand, HIR2 pointed the study to a list of expected skills to be achieved by students who successfully complete the programme and these include the ability to:

- 1) Manage and coordinate health informatics projects
- Demonstrate an understanding of the theory and recurring fundamental concepts of health informatics
- Apply the knowledge, skills and insights acquired on this programme to the demands of professional environments
- 4) Integrate computing and managerial knowledge and experience with health related knowledge and experience
- Analyse healthcare informatics systems and healthcare management processes and advise on change management and implementation
- 6) Assess the use of technology to assist with decision making
- Illicit and express user requirements for healthcare informatics systems
- Evaluate the opportunities and limitations of information technology and of its impact in improving the efficiency, cost-effectiveness, safety and quality of healthcare delivery
- Formulate, evaluate and apply evidence based solutions in the delivery of healthcare
- 10) Embrace new technologies that arise in health informatics
- Recognise the need for continuous learning in informatics skills and knowledge
- 12) Ask the intelligent questions to the relevant parties.

(Jaspers and Hasman 2007)'s list of expected outcomes reviewed from the literature might have used different wording, but the content is very similar to what HIR2 referred the study to (see section 2.10).

Students who graduate as Health Informaticians often end up as Systems Analysts, Project Manager, Data protection and Privacy officers, health informatics and technology policy makers, health systems consultants, directors and Chief Information Officer Researchers, Nurse Informatics Educators, Health Academic Librarians, Clinical Education Officers, Consumer Business Analysts, Information System Developers, Clinical Information System Coders, Health Industry Representatives amongst more within the health sector (AHIMA 2006; HISA 2011).

#### 4.4.3. Programme Application Requirements

The health sector employs a cross-section of employees with various qualifications, ranging from Certificate, Diploma, Bachelor's Degrees, and Masters Degree (or even higher), who all work with health information systems. It is common in Uganda to find Healthcare Information Officers who have been working with health information systems (manual/ paper-based), but have no skills in the basic concepts of information science (Omona and Ikoja-Odongo 2006).

The study asked HIR2 to identify the target group of students who enrol in their programme and what the basic requirements were. HIR2 responded that their programme catered for candidates from the healthcare professional background, who hold at least have a primary undergraduate degree in either Health or Computer Science or alternatively with 5 years' experience in the healthcare domain.

The students group targeted by HIR2 include professionals from the Healthcare Administrative background, Healthcare Specialists / Clinicians, and IT Specialists only if they are working within healthcare.

Similar to HIR2, HIR1 designed their programme for healthcare providers with an interest in Evidence Based Medicine as well as Health and Medical Research and the target group includes Doctors, General Practitioners, Consultants, Nurses, Physiotherapists, Speech and Language therapists.

HIR2 emphatically stated that "one requires to have an appreciation of health, which includes Social, Ethical, Cultural, Legal and Organisational aspects", which need to be second nature for those who wish to pursue the academic programme.

HIR2, therefore do not offer the course to participants from non-health disciplines and regard this category as lacking the "nuances and peculiarities" in respect of the required healthcare appreciation.

For example, to enrol to the Masters of Health Informatics programme in the University of Dar es salaam, Tanzania, the minimum qualification requirements for admission is either Lower Second Class Bachelor of Science degree from a recognised University or a Postgraduate Diploma in an appropriate discipline (UDSM).

Unlike the few Health Informatics education centres reviewed, the University of Washington was unique in some way, that it was one University, which never specified the minimum requirement of Bachelor degree in Health Science or even Computer Science. Anyone with a Bachelor's degree from any discipline could enrol into the programme, however there was a prerequisite of having completed three modules in mathematics (including statistics), computer programming (at least two quarters), and biology (or zoology).

While at Oregon Health & Science University (OHSU), the application requirements to enrol to the Master of Science in

Health Informatics is either a Bachelor's degree in computer science, engineering, biology, biochemistry, nursing, mathematics, statistics, physics, information management, or a health-related field or a similar discipline. However, there is a prerequisite of at least one introductory course in computer programming before entering the programme.

#### 4.4.4. Health Informatics Core Competences

The eight main components identified by Brittain and Norris (2000), should be included in the health informatics curriculum. These include Communication, Knowledge Management, Data Quality and Management, Security and Confidentiality, Secondary use of Clinical Data and Information, Clinical and Service Audit, Clinical Systems and lastly, Telemedicine and Telematics.

HIR2 suggested that the "curriculum should focus on the big issues related to health informatics, such as interoperability, security, standards in health informatics vocabularies and messaging services, etc".

HIR1 remarked that "it is not of importance to have to teach participants how to write computer programs, however concepts or appreciation of programming languages may be imperative, as well as languages such as HL7" (Health Level Seven)<sup>18</sup>. In agreement with HIR1, HIR2 suggested introducing students from the healthcare background to the fundamental concepts of software development, but it does not mean that they need the competency of software developers. All they require to have is an appreciation.

For instance, the course structure at Centre for Health Informatics (CHI), City University London included eight compulsory core modules, which included topics such as

<sup>18</sup> http://www.hl7.org

Introduction to clinical records, Databases and data analysis in healthcare, Information architecture, Decision support systems, Knowledge management in healthcare, Research methods, Healthcare professional Issues and Telemedicine (CHI, 2011).

#### 4.4.5. Health Informatics Course Content

In order to review and analyse the course content of the Master's degree programme in Health Informatics that are currently offered, the study identified six academic institutions, the University of Victoria in Canada (UoV), the University of Dar es Salaam in Tanzania(UDar), the University of Heidelberg/ Heilbronn in Germany (UHH), the Universities of Washington (UWA), Minnesota (UMN) and Utah (UUT), all three from the United States of America and gathered information on the course material from the institution's websites.

The information from the course content of the six universities were then populated into a simple electronic spread sheet together with the programme content for the  $10 \times 10$ programme designed by AMIA in collaboration with Oregon Health and science University and IMIA's educational recommendations of the Health Informatics skills and core competences (see Appendix 4). The information was then coded based on theme of the topics, which resulted into 14 categories as described in Table 16.

The results revealed the comprehensiveness of IMIA academic recommendations as compared to the six academic institutions programmes, as well as AMIA's 10 x 10 training programme, as seen from Table 16 and also from **Figure 6**.



**Figure 6:** Describes the frequency of Health Informatics course content categories offered at the six institutions compared with IMIA's educational recommendations, AMIA 10 x 10 programme and the course content identified by Brittain and Norris (2000).

Category	Code	IMIA	AMIA	Brittain	UWA	UHH	UUT	UoV	UDAR	UMN	Total
Health Informatics	HI	1	1	1	1	1	1	1	1	1	9
Project Management &	O&M	1	1	1	0	1	1	1	1	1	8
Organisation in healthcare											
Policies & Safety	QM	1	1	1	0	1	1	1	1	1	8
Health Information Systems	HIS	1	1	1	0	1	1	1	1	1	8
Healthcare Research methods	HRES	1	0	0	1	1	1	1	1	1	7
Decision Support systems &	DSS	1	1	1	0	1	1	1	0	0	6
Tools											
eHealth	eH	1	1	1	1	1	0	1	0	0	6
<b>Basic Computing Science</b>	BC	1	1	0	0	1	1	0	1	0	5
<b>Basic Health Science</b>	BHS	1	0	1	1	0	1	1	0	0	5
Bioinformatics	BI	1	1	1	1	0	1	0	0	0	5
Medical Imaging	IMG	1	1	1	0	1	1	0	0	0	5
Human Computer Interaction	HCI	1	0	0	1	0	1	1	0	0	4
Knowledge management, Data	KDD	1	0	1	1	1	0	0	0	0	4
Mining											
Standards, vocabularies,	STD	1	1	0	0	1	1	0	0	0	4
terminologies, ontologies and											
taxonomies											
Total Score on the Number of		14	10	10	7	11	12	9	6	5	
<b>Topic Category for Institutions</b>											

The analysis uncovered that among the top ten categories were topics such as the Evolution, Overview and Principles of the Health Informatics as a discipline, Organisational behaviour, Project and change management, Policies, guidelines and patient safety related issues, health information systems, healthcare research. Decision Support Systems, Software development and information processing and Analysis. Figure 14 illustrates the entire frequency distribution of the 1 topics categories, results that could present an interesting debate, but due the time constraints and the research scope, the subject shall not be discussed in this study.



**Figure 7:** Categories of the most popular courses within Health Informatics programmes at Master's level

However, there were some interesting observations from the University of Dar-es-Salaam, Tanzania's results, which could be used to guide the study on what topics to be recommended for the Health Informatics curriculum in Uganda.

The results from UDAR all happen be among the first top ten frequently covered topics in the Health Informatics programmes for the institutions that were studied. Based on the economic status and the present needs of the country, the study would deduce that to be true, for the reason that, Tanzania is a developing (which is also very close to Uganda), which is also facing infrastructural challenges similar to the ones in Uganda, such as lack of Internet connectivity, lack of computerised systems within the health facilities, and more. For instance, teaching students on how to develop Decision Support System and tools, when there are no computerised systems implement them with, seem a misappropriation of resources. However covering topics such as the role and benefits of Health Informatics in healthcare, patient safety and guidelines, benefits for implementing and managing health information system, etc., seem more relevant to the cause.

From these observations, the study was in better position and had a clear picture of the type of topics which were to be recommended as part of the Uganda Health Informatics academic curriculum.

#### 4.4.6. Programme Workload

HIR1 added that "it is gratifying for one to be honoured for their achievements". Therefore the programme should be designed in such a way that there are set exit levels within the programme, where a learner could obtain a reward for what they have accomplished.

The programme workload at the Centre for Health Informatics, City University London, including the eight modules and a research thesis, which all amount to a total of 180 ECTS credits, in order for a student to successful complete the M.Sc. in Health Informatics programme. While the Health Informatics programme workload at the University of Dar es salaam requires a student to complete 10 modules, worth 25 CGPA points and chooses one option from a list of three, which is worth three CGPA points.

For example, at the Addis Ababa University, in Ethiopia, in order a students to complete successfully the master's

degree programme in Health Informatics, they are required to meet the following requirements:

- 8.5 modules + thesis or 10 modules + comprehensive
- An overall CGPA of at least 3.0

Note: CGPA stands for Cumulative Grade Point Average value, which is an overall indicative percentage of marks obtained by the students in modules or subjects taken. For example, the Grade Points obtained in all the subjects are calculated along with the total number of credit hours you have attempted.

Figure X is an illustration of who the CGPA points are graded, however, the CGPA19 value and percentage of marks can be assessed as follows:

• Subject wise indicative percentage of marks = 9.5 x GP of the Subject.

SCHOLASTIC A			SCHOLASTIC B and Life Skills**			CO-SCHOLASTIC ACTIVITIES AND HEALTH & PHYSICALEDUCATION			
MARKS RANGE	GRADE	GRADE POINT		GRADE	GRADE POINT		GRADE	GRADE POINT	
91 - 100	Al	10.0		A+	5		A +	3	
81 - 90	A2	9.0		А	4		А	2	
71-80	Bl	8.0		B+	3		В	1	
61 - 70	B2	7.0		В	2				
51 - 60	C1	6.0		С	1	1			
41 - 50	C2	5.0				1			
33-40	D	4.0				1			
21-32	E1								
00 - 20	E2								

• Overall indicative percentage of marks = 9.5 x CGPA.

Figure 8: Illustrates the CGPA Grading Pattern, used in Uganda, Tanzania, Ethiopia and Rwanda. Image Source from (www.icbse.com/cgpa/ 15/09/11)

<sup>&</sup>lt;sup>19</sup> http://easycalculation.com/statistics/cgpa-calculator.php

#### 4.4.7. Programme Duration and Structure

The study asked HIR1, what the appropriate duration would be for running a programme if the duration was standardised to which HIR1 responded "Health informatics training is not the same as training an Olympic athlete". The study interpreted this to conclude that training is at a different pace with different content for each target student and that the objectives of each entry onto the programme was specifically designed to meet certain needs and that these needs change, not only to meet operational requirements but also to offer recognition and/or career advancement.

HIR1 went on to add that the training of a Health Informatician could take anything from one month up to 2 years. The determinants for duration vary according to:

- the expected outcomes of the programme
- what the learner's needs are
- what the learner is expected to achieve
- at what level the learner expects to exit the programme from

Therefore while designing the academic programme, careful consideration needs to be given to the flexibility of content and duration to meet different entry level needs and outcomes.

For example, the Health Informatics programme structure at Centre for Health Informatics (CHI), City University London runs for a period of 12 months (Full-time) and 28 months (Part-time) during the day.

While the programme at OHSU operates on a quarterly basis, so a full-time student should be able to complete the coursework portion of the program in 4-5 quarters.

The Health Informatics programme at the University of Dar es salaam is conducted for a period of 24 months full-time and 30 months part-time (UDSM).

#### 4.5. Qualifications and Career path

When the respondents were asked what mechanism was in place to determine the participant's career path, HIR2 highlighted that they employ a system similar to the "QCA System" (Qualifications and Curriculum Authority), whereby a learner has to achieve a certain amount of credits, before being allowed to proceed to the next level.

The system is scored to a total of 4 points, whereby a learner can only proceed to the Higher Diploma level if they have obtained a score of 2.6 points or more. Learners who do not make this grade, are awarded a certificate

Higher Diploma students, who obtain more than 3.2 points, can opt to continue onto the Masters Degree programme. Those who opt out, are awarded a Higher Diploma.

Similar to HIR2, HIR1's programme is also designed in such a way that there are three exit levels. The first one is at Certificate level, the second one is at Higher Diploma level, followed by a Master's level as previously described in Table 8. There are also opportunities for pursuing further studies, up to and beyond PhD level.

**Figure 9** describes the career path paradigm for Health Informatics students, starting from certification to the PhD or even higher, specialising in various areas of Health Informatics described in appendix 2, through research, long-file learning and Practice.



Figure 9: Holistic Conceptual Learning Model – Adapted from the University of Victoria, Canada (Lau, 2007)

#### 4.6. Collaboration with Other Medical and Academic Institutions

Both HIR1 and HIR2 noted the importance of collaboration with international partners who have been involved in health informatics programmes. They emphasised the importance of bringing experience and knowledge on board where these resources can promote development and growth.

#### 4.7. Other Useful Comments raised from the Interviews

The study asked respondents about the applicability of using a programme design which is international or which is used in other institutions and HIR1 responded by stating that, "Health Informatics Programmes in Europe might not be applicable to serve the African needs, as well as programmes designed for one country may not be suitable for another without customisation of the core programme". HIR1 went on to add that, "there is a need to establish local requirements, which need to be taken into consideration when developing the academic curriculum".

HIR1 highlighted to the study about the lack of communication between Information Technologist and Clinicians that still exists due to the speciality background, a challenge which can only be addressed by Health Informatics. While conducting an interview with MUKR1<sup>20</sup>, the study discovered that the College of Computing and Information Science in collaboration with the College of Health Science were in the process of drafting a proposal to form either a Health Informatics and Research Department or a Centre for Health Informatics Research at Makerere University.

The proposed centre would be aimed at training health informatics professionals who are to be deployed to manage the expansion of the information system infrastructure in Uganda and also to conduct appropriate research geared towards understanding, creating and applying new methods for modelling, managing and acquiring information in Biomedicine.

In the middle of 2011, the School of Computing and Informatics Technology met to introduce and initiate the proposition for the establishment of the Health Informatics training centre and also formulate mission, goals and objectives, as well as identifying the possible partners from north and south of the borders.

In learning this information, the study confirmed that the Ministry of Health as well as one of the strong non-governmental supporting research partners were not aware of the developments, which suggests a lack of collaboration and involvement of all potential stakeholders. This discovery emphasised the critical need to identify all major stakeholders and engage them in dialogue.

<sup>&</sup>lt;sup>20</sup> MUK1 – Represents the respondent who was interviewed by the study from the School of Computing and Informatics Science in Makerere University, Kampala.

# **CHAPTER 5**

# RECOMMENDATIONS

#### 5. **Recommendations**

#### 5.1. Introduction

This chapter addresses the recommendations based on the findings in chapter 4, however, the study would like to address some challenges that need to be given consideration before and while designing the Health Informatics academic curriculum for Uganda.

Unlike developed countries, availability and access to the internet is still a problem in the Sub-Saharan counties, including Uganda.

According to (Urama, Ozor et al. 2010), Internet usage has been slow to pick up in developing countries due to the lack of communication infrastructure. In 2008, over 900 km of high-capacity optical fibre was laid around Kampala (Uganda's capital) as part of the national backbone fibre infrastructure phase one, and another 1,500 km was to be laid by the end of 2009.

Appendix 3 shows the percentage of Internet usage in Sub-Saharan countries between 2002 to2007, however access to Internet connectivity remains mostly in urban areas (Urama, Ozor et al. 2010), and the same applies to Uganda.

Infrastructure to provide power supply is not consistent and regions are affected by interruptions where the availability exists.

The same applies to the availability of internet. The majority of households do not yet have access. Where employers and health facilities have access, access is limited and/or restricted and thus infrastructure to support on line programmes is not in place.

This also impacts on any health systems that rely on internet access for data exchange and as such, users may not have the ability to carry out online research work or even access online communication tools.

(Urama, Ozor et al. 2010) also suggest the low computer literacy among Ugandans, a challenge which is affecting the health sector as well, since not all Healthcare professionals are computer literate.

# 5.2. Project Initiation Steps

Based on the findings from the research, the study analysed the information that was acquired and formulated the steps in **Figure 10**, which could be followed by the project committee to initiate the project for building capacity in Health informatics at Makerere University in Uganda.





The project shall be iniated by the Ministry of health, who will lead the initial meeting of all potential stakeholders where they shall meet and debate matters related to the building of health Informatics capacity.

# 5.3. Stakeholders Responsibilities in Brief

Findings from the literature review and from the structured and unstructured interviews highlighted key areas to the study from which to identify potential stakeholders. However, it should be noted that these are not the only stakeholders, but part of the group who have been identified as crucial to drive the project. The study recommends nomination of a project champion, with the mandate to identify all manager stakeholders, engage them in dialogue, in order to formulate the mission, goals and objectives for initiating and implementing this venture (as per recommendations from HIR1), and the study believes that the ideal person should come from the Ministry of Health.





Therefore, the study recommends that the Head of the Ministry of Health's Resource and Information Centre should send official introductory letters to both the College of Health Science and the College of Computing and Information Science, inviting them for a formal meeting. The letter should address the main objective of the requested meeting including the expectations from the two colleges, which include commitment to the subject (Building Capacity Health Informatics) as well as agreement of the way forward.

The Resource Information Centre will then be responsible for the appointment of representatives of the stakeholders identified from category 1, to be part of the project steering group and project committee.

The responsibility for the nominated individual in category 1 shall be to bring forward to the project committee the Health Information needs of the health sector, identify and evaluate employees that require training or enrolment onto the programme. They also have to take an active role in engaging in dialogue with other stakeholders to ensure that all the health sector's information needs together with the outlined goals and objectives are fulfilled.

Stakeholders from Category 2, who comprise of prospective students from healthcare, shall be involved in the evaluation of the academic programme through a feedback mechanism, and shall participate in the redesigning of the academic curriculum, to ensure that it meets the students needs.

The study recommends that the Deans of the six schools (i.e. Biomedical, Public Health, Health Science, Medicine, Computer Science and Library Information Systems) who are in stakeholder category 3, shall nominate representatives to serve on the project committee in order to facilitate collaboration and contributions to the project from each of the College and/or School departments.

The responsibilities of appointed persons in category 3 shall be to formulate the goals, objects and expectations of their schools, as well as identifying the roles they will be playing in the project.

The stakeholders in category 4 (which are made-up of International academic and research partners), should be contacted and invited to the venture by the steering committee. They have the potential to share their skills and knowledge in the form of consultancy on various issues such as the setting up of the centre, curriculum design, participation in

the provision of guest talks and lectures, and facilitate the formation of partnerships with their home Health Informatics centre, etc.

Category 5 stakeholders, also play a critical role in the project, in terms of sponsoring and funding the initiative as well as promoting the agenda to build capacity in Health Informatics (including other areas) at the top governance level.

#### 5.4. Curriculum Design to Adopt

Based on the literature reviewed, some of the goals for building capacity in Health Informatics are for improvement of the healthcare service delivery and patient care through the utilisation of ICT as an enabling technology (Haux 2010).

The developed programme should also aim at providing a long-term stable study and work environment and promoting the intellectual development for both students and staff members in terms of professional progression and social conscientiousness.

The goals and objectives of the curriculum design should be aligned with health sectors and the academic institution's strategic plans, and should be aimed towards the development of intellectual growth of the students and staff members as well as improving the Health Sector's service delivery and patient care.

#### 5.4.1. Expectation

Based on the research findings on the expected outcomes from the health informatics programme as suggested by HIR2 during the research interviews as well as (AHIMA 2006; IMIA-WG1 2007; Jaspers and Hasman 2007), the students who pursue the programme shall have the ability to demonstrate an understanding of the theoretical and recurring basic concepts of health Informatics and also be able to apply the acquired knowledge and skills to manage and coordinate Health Informatics projects in their own work environment. Other skills that students could demonstrate include the ability to illicit user requirements, analyse them and design high level systems which could be used in system developments by qualified software developers, as well as being able to ask the intelligent questions of the relevant health providers. They are also expected to analyse existing systems and advise how the change management process should be initiated and implemented as well as overseeing the effective delivery of solutions which are compliant with the health sector's standards and regulations (HISA 2011).

#### 5.4.2. Application Requirements

Bases of the literature (CHIME 2011; TCD 2011; UCL 2011; Utah 2011), prospective students to be considered for enrolment onto the Masters of Science in Health Informatics should primarily come from the healthcare background and should hold a health science Bachelor's Degree.

A mechanism should be put in place, to consider prospective students who do not have a health science primary degree, but have been working and involves in the provision of health information systems support, as well as those involved in the organisational management for a number of years.

The study recommends that the Masters of Science in health Informatics programme should be designed for students with a minimum of an undergraduate primary degree in either Heath Science or Computing and Informatics Science, and working in the healthcare environment, although it may attract other professional from different background seeking for a career change.

Based on the literature review with regards to the admission requirements to the Master's degree programme in Health Informatics (MUK-Statute 2006), the study recommends that students who wishing to enrol must primarily fulfil the general entry requirements for the Master's Degree level in Makerere University and in addition and must hold either hold:

- A postgraduate Diploma in either a Health or Computing and informatics Science discipline from a recognised university/ college / Institution or
- A Bachelor's degree not lower than second class (an equivalent of a 2.2 in Ireland) in either a Health or Computing and informatics Science discipline from a recognised university/ college / Institution or
- iii. Any other degree with evidence of have either taken acceptable education programmes in either Health Science or Computing and Information Science or proof of having worked within the Health Sector for at least five years.

# 5.4.3. Programme Content

The Healthcare Informatics curriculum has to be based on the local health sectors needs and suggested by Brittain (2000) in the literature and HIR1 during the structured interview sessions. Other recommendations to consider, includes IMIA's educational recommendations described in Section 2.11 and in particular the core competencies (see Appendix 4). AMIA in collaboration with the Oregon Health and Science University (AHIMA 2006; AMIA-Web 2011), developed training programme known as the 10x10 (as described in section) which had some interesting topics.

The study also reviewed academic programmes from the Centre for Health Informatics of the University of London, as well as the programme offered at the University of Victoria in Canada, University College Dublin and the Medical Universities of Heidelberg/Heilbronn. After a critical review and analysis of these programmes, the study came up with the following recommendations of topics which have to be included into Uganda's Health Informatics academic curriculum to be designed.

The programme to be designed must aim at building Health Informatics capacity with the right mix of skill and knowledge, and therefore, below are the recommendations of the selection of topics which should be included in the academic programme.

Based on the finding from the research with regards to Uganda Health Informatics needs together with what the international experts in the field of Health Informatics (IMIA-WG1 2007) together with the academic well established academic institutions that provide teaching and research (UDSM 2011; UH-MI 2011; UNM 2011; Utah 2011) in the same domain, the study recommends that:

- Uganda follow IMIA's educational recommendations of the required skills and core competences as a baseline while designing the Health Informatics curriculum
- Base the design on Uganda's Health Sector Information needs as described in section 4.2 of the research findings chapter and Appendix 13.
- 3) The topics listed below should be considered as part of the course modules due to the reason that, that is where Uganda's current Health Informatics occur, with the top:
  - Health Informatics
  - Health Information Systems
  - Decision Support systems & Tools
  - Healthcare Research methods
  - Healthcare Organisation & management
  - Human Computer Interaction
  - Policies & Safety
  - Basic Health Science
  - Bioinformatics
  - Medical Imaging.

# 5.4.4. Programme Workload

Based on the finding from the research and the recommendation from IMIA, the study recommends that a student should register for six compulsory core modules , One elective modules, two class exercises and a Master's thesis at the end of the taught programme as illustrated in Table 11 with a total of at least 30 CGPA points.

Core Modules	6	3	18
Electives	1	3	3
Group Project	1	3	3
Seminar / Personation	1	3	3
<b>Research Thesis</b>	1	6	6
Total CGPA			33

**Table 11:** Illustrates the recommend programme workloadby the study, based the knowledge acquired fromthe study (UUT, UDAT, UMN, Ethiopia)

The electives have to be formulated from topics which are considered to be critical to Uganda's health sector's needs, but they are not part of the internationally Health Informatics core competences. Such lists of elective topics shall be provided by the Ministry of health and update on an annual basis, based on the evolution of the needs.

Group project topics could be selected by the students based on problems in their work environment, while thesis research projects are to be supplied initially by either the College of Health Science or the Ministry of Health.

# 5.4.5. Programme Duration

Based on the literature and the evidence shown from a few of the institutions which offer Health Informatics, the average duration for a Master programme should run for at least more than 12month on a full-time basis and at least more than 24 month on a part-time basis (refs) Taking into consideration the University academic structure breakdown in Table 13 and the sample programme duration in Table 12, the study recommends that the programme should be designed to last for a period of one year (2 semesters) on a fulltime basis or 24 month (4 semesters) on a part-time basis.

The table below provides a description of durations of various the academic programmes conducted in Makerere University for qualifications ranging from a postgraduate diploma to a Doctor of Philosophy for both fulltime and part-time programmes. This information also serves a point during the curriculum design process.

Sample Programme Duration						
Diplomas	One academic year					
Masters degrees (full time)	Two academic years					
Masters degrees (part time)	Three – four academic years					
Masters of Medicine	Three academic years					
Master of Public Health (Day)	Three academic years					
Master of Public Health	Three to six academic years					
(Distance)						
PhD (Provisional Admission)	One academic year Maximum					
PhD/MD/LLD (full time)	Three academic years					
PhD/MD/LLD (part time)	Five academic years.					

Table 12: Describes the standard duration taken to complete a

programme in Makerere University (Source – MUK Site)<sup>21</sup>

Sample College Semester Breakdown Structure					
11/08/2012 - 17/08/2012	Orientation Week	(7days)			
18/08/2012 - 15/08/2012	Semester One	(17 weeks)			
15/12/2012 - 26/01/2013	Semester One Vacation				
21/01/2013 - 25/01/2013	63rd Graduation				
26/01/2013 - 25/05/2013	Semester Two	(17 weeks)			
25/05/2013 - 17/08/2013	Semester Two Vacation				
25/05/2013 - 03/08/2013	Recess Term	(10 weeks)			

Table 13: Describes a Sample of the College Semesterbreakdown structure at Makerere University to beconsidered while designing the health Informaticsacademic curriculum – (Source: (MUK-Web 2011))

<sup>&</sup>lt;sup>21</sup> http://mak.ac.ug/index.php?option=com\_content&task=view&id=35&Itemid=95

#### 5.5. Computer Literacy Programme

Therefore, there is need to design a basic computer literacy programme, similar to equips healthcare professionals with basic computer appreciation skills such as Word processing, Data applications, use of electronic spread sheets, use of Internet technologies such as the World-Wide Web, electronic mail and other social networking tools.

The school of Computer Science and Informatics in Makerere University, offer short-term certifications programmes in International Computer Driving Licence (ICDL), Certificate in Computer Applications (CCA), Geographical Information Systems, Multimedia Courses and Staff Development Program (Advanced End-User Training Programme in ICT Skills)<sup>22</sup>(COCIS-Web 2011). Such programmes will offer participants fundamental computer appreciation skills and they prepare for feature enrolment onto the Health Informatics Programme.

The other option the study recommends is that, the Ministry of health could create a team of Information Technology instructors within the health sector, who could take on the role of providing basic computer skills to the healthcare professional around the country. In Zimbabwe, a local ICT firm known as "Nhava Global", launch a mobile computer training school in October 2020, which was aims to bridging the gap of the digital divide that exists between the rural and urban of Zimbabwe as well as boosting the ICT literacy levels in the remote area (Nhava 2010).

The Ministry of health could adopt such a strategy, which will primarily create employment opportunities to the team who are providing the training programme, as well as improving the literacy levels of healthcare professionals who are located in the remote areas of the country and have no access to computer facilities.

<sup>22</sup> 

http://cis.mak.ac.ug/psd/index.php?option=com\_content&view=category&id=34&Itemid=5 3 (13/09/11)

The other added benefits is that, the computers on wheel programme would be similar to an in-house training programme, where the syllabus is designed based on the health sector's need and aligns with the health services goals and objective, such as the promotion of Health Information System (HSICTP 2006; Vision-2012 2009).

In case the Ministry of Health has not organised in-house training programmes, healthcare professional who require the basic knowledge on how to use and operate computers should enrol on such programmes.

The school of Computing and Information science presently offer Diploma and Certificate programmes in:

- Diploma in Computer Science
- International Computer Driving Licence
- Certificate in Computer Applications.

#### 5.6. Collaboration through Research Developments

Research plays a critical role in creating a sustainable science culture, which will promote the quality of services in the health sector. The government of Uganda has a mandate to give high priority towards research for the next decade in order to support evidence-based polices and formulation solutions to existing gaps in the system which require improvement (NHP 2009; NDP-2015 2010). Other areas that can benefit from research include finding solutions for those with special needs and the most vulnerable in the society, but most importantly, guide the development and implementation of healthcare polices as well as sorting solutions for disease prevention, early diagnosis and treatment.

Postgraduate research for the developed programme should core part of the academic programme and should focus on conducting practicalbased research, which will yield tangible outcomes at the end of the studies, as well as also enabling students to write and publish their results either in local or international journals. During the structured interviews conducted with the Centre of Disease Control, the officer in charge of the informatics section presented the study with a number of research topics, which could considered as part of the dissertation or thesis research topics for the finalist students, and the topics in question are provided below:

- Harmonizing multiple health information systems through effective system analysis and design
- Current and future challenges for the national Health Information Systems
- Health information policies and legislations
- Health Information Systems standards for interoperable information systems
- Tracking and monitoring health systems performance nation wide
- Issues related to Financial and human resources for Health Information Systems
- Universal access to health and health services: Essential information to track progress and support management. From measuring inputs to measuring impact?
- Enhancing global health security: information systems as the foundation of effective pandemic preparedness and response
- Improving transparency through collaboration across sectors
- Managing complex data in health crises: challenges for national health information systems
- Development and implementation of Health information policies and legislations
- Improving transparency through collaboration across sectors.

# 5.7. Formation of Collaborations

Establishing collaborations with other educational and medical research institutions should be highly considered as it exhibits benefits such as maximisation of resource, saving of costs, sharing of knowledge and promoting scalability, students and teacher exchange programmes, lectures beyond geographical boundaries, amongst many, as suggested by (Ammenwerth, Haux et al. 2003; Leven, Knaup et al. 2004) with regards to the International Partnership in Health Informatics Education<sup>23</sup>

Setting up collaboration with other Health Informatics teaching and research institutions from the neighbouring region will be worth investigating, and where applicable established. At present, the University of Dar es Salaam in Tanzania, Addis Ababa University of Ethiopia and the National University of Rwanda, all to provide Health Informatics academic programme, though the curriculum content may vary.

Collaboration is recommended not only to stop at local or regional level, but even beyond the African continent as already established from the findings section of the report.

There is a need to promote healthcare or medical science research in order to strive towards the highest quality research in health informatics innovations with the aid of collaborative partners and other healthcare providers (IPHIE 2011).

#### 5.8. Process of Submitting New Programme Proposal

According to section 18 of the Makerere University Statute (MUK-Statute 2006), "a College Academic Board, with the approval of the University Council, may establish Faculties, Departments, Institutes and Centres either in addition to or in substitution of the Faculties, Departments and Institutes established under subsection (a) and (b) of this section, where (a) is a four-tier College structure shall be made up of Faculties, Departments, Institutes, Centres and such other Units as may be established by the University Council and (b) is a three tier

<sup>&</sup>lt;sup>23</sup> http://www.iphie.org/

College structure shall be made of Departments, Institutes, Centres and such other units as may be established by the University Council".

Therefore, when planning establish a new unit or academic programme within the University structure, the school which shall take the role of leading the project, has to draft a proposal in collaboration with all academic stakeholders involved in the process. This includes the four schools from the College of Health Science and the two School in the College of Computing and Informatics Science (see Appendix 10, Appendix 11 and Section 4.3 of potential stakeholder).

Formulation of the proposal goal and objective is conducted at the department level (see Appendix 10 and Appendix 11), from the department, the proposal is sent to the School management committee, from the school management committee, it is forward to the College Higher Education and Research Board, and then lastly sent to the Senate for the final approval<sup>24.</sup>



Figure 12: Process of Submission of academic programme proposal to be approved by the university Senate

 $<sup>^{24}</sup>$  Information acquired through the Dean's office of the School of Engineering in Makerere (29/09/11)
Figure 12 highlights the process followed to apply for a new academic programme in Makerere University. The Process starts at the Unit or School level, reviews by the College Board and then finally has to be approved by the University Senate. See Appendix 12 for the detailed institutional governance structure.

#### 5.9. Dates for the Senate meetings 2012

The dates listed below highlight the meeting time schedule of the University Senate and could be used as reference points to guide the right period to submit the Project proposal for the academic programme:

- 8<sup>th</sup> February, 2012
- 18<sup>th</sup> April, 2012
- 18<sup>th</sup> July, 2012
- 19<sup>th</sup> September, 2012
- 21<sup>st</sup> November, 2012.

# CHAPTER 6 CONCLUSIONS AND FUTURE RESEARCH

#### 6. CONCLUSIONS AND FUTURE RESEARCH

Dr Mike Strong, Coordinator of the United States President's Emergency Plan for AIDS Relief said at the Uganda Health Data User workshop which was held 2010 that "It is important to be smart in how you use the limited recourses at your disposal", a point this study concur with strongly.

This study should have concentrated more on the identification of stakeholders as well as their roles and involvement in the building capacity in health informatics venture.

This is the right time and opportunity to start building capacity in Health Informatics, since most of the potential stakeholders are in discussions and are willing to initiate this venture.

The research project found that crucial infrastructure in respect of access to computer hardware, Internet and skills were not the only components hampering the establishment of Health Informatics curricula in Uganda.

The research found that harnessing a partnership between the schools of Computer Science and the College of Health Services, could leverage the availability of existing infrastructure services and skills between the two schools which would create the ideal platform to initiate a research project for the establishment of a Health Informatics course that would benefit both institutions.

However, the historic indifferences and rivalry between the schools prevent such a partnership and even though the Centre of Disease Control and the US Aid Relief Agency are willing to invest in such a venture, the schools still are not prepared to unite or partner and continue to rally on their own in an attempt to establish a lead and manifest control.

In order to establish a Health Informatics course that could:

- overcome logistical and infrastructural difficulties
- meet health services needs
- harness existing availability of resources to manifest savings in time for setup and investment

 achieve integration between the two professions to ultimately meet the aim of delivering improvement in the health sector and as such patient care (life expectancy still being lower than 50 years in Uganda without considering the impact of domestic health risks), a partnership between the schools is vital.

As the conflict is historic and the parties' perceptions are dominated by their own needs, they are unable to sit down and listen to reasoning. Intervention in the form a mediator with problem solving negotiation skills is needed to bring them together.

The negotiation course of Stuart Diamond, who teaches at the Wharton School of Business and who is also Adjunct Professor at the Penn Law School, has been taught at leading institutions including Berkeley and Oxford.

The teaching is of particular value in the area of uncovering and trading needs, starting with rivalry parties and taking each back to a basic hierarchy of psychological needs (Abraham Maslow's hierarchy of needs) especially as the project involves public issues. Stuart Diamond argues that 55% of the negotiation effort needs to be devoted to the people in the room. That is taking the emotional and situational temperature of all parties including possible third parties, before commencing the negotiation process which should apportion 37% of the process. A mere 8% of the effort is required to address substance, the argument in the negotiation process.

Once the parties are taken back to basics and allowed to interact on common and mutual human grounds, mediation can start by bridging differences incrementally to allow both parties to digest and embrace issues against the possibility of a partnership where goals and standards can be used to trade each off against needs that are uniquely of value to each school (Diamond, 2010).

A vote of thanks to all those who participated in the study, and also to those who pledged their willingness to support the project in any form as assistance

As Brittain and Norris (2000) highlighted that, there will always be need to train or educate healthcare professions on usage of specific health informatics system and the demand will continue to grow as due to advancements in technology, as well as the need to obtain internationally recognised qualifications.

There is a need to redesign and internationalise the Health Informatics curriculum, and also to promote Health Informatics as a recognised professional world-wide, enabling qualified informaticians to take on employment anywhere in the world.

#### 6.1. Some Future Considerations

#### 6.1.1. Curriculum Designs

The University College Dublin, a third level academic institution in Ireland, introduced a taught Master's Programme in Negotiated Learning. The uniqueness about this programme is that, it offers a student the opportunity to choose and negotiate a programme tailored and aligned to their own career needs and goals, instead of the traditional designed programmes, from a cross-section of modules offered from various schools of the college (NL 2011).

Such a model should be considered for the future design of the Health Informatics Programme, whereby a list of topics a set out, and students pick what they need to learn, as long as to fulfils the masters programme requirements, in terms of the expected workload, points or credits to be earned and confirms with the university's rules and regulations.

Some of the advantages with such a model is that, organisational managers do not have to spend time learning what they already know, and the same applies to clinicians, information technologist and all other healthcare professional involved in the health information management domain, but instead utilise the time elsewhere their services needed most.

However, there is also a need to introduce a mechanism, to assess the student's needs, and ensure that the goals and objectives of the programme are not swayed as well as the hampering the quality of the capacity produced.

#### 6.1.2. Health Informatics Society of Uganda

The shall be need to establishment a Health Informatics Society of Uganda, which can be accomplished by the Ministry of Health in collaboration with Makerere University and other interested partners. The society will serve as central point for health informaticians and those with an interest in health informatics, and also be used for raising awareness of the benefits from Health Informatics.

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# **APPENDICES**





**Figure 13**: The Map of Uganda showing the international and district boundaries – (Source UBOS)



# **APPENDIX 2: DISCIPLINES INVOLVED IN HEALTH INFORMATICS**

Figure 14: Highlights and describes the multidiscipline involved in health and medical informatics – Source: Adapted from (Mantas, Ammenwerth et al. 2010)



# APPENDIX 3: INTERNET USAGE IN SUB-SAHARAN AFRICAN COUNTRIES

Figure 15: Illustrates how percentages of sub-Saharan African Countries level with Internet Access per 100 population, between 2000 and 2008. Source: United Nations Statistical Division, Millennium Development Goals Indicators in (Urama, Ozor et al. 2010)

1. Biomedical and Health Informatics Core knowledge and Skills				
	Knowledge or Skill Domain	IT User	BMHI Specialist	
1.1	Evolution of informatics as a discipline and as a profession	+	+	
1.2	<b>Need for systematic information processing</b> in healthcare, benefits and constraints of information technology in healthcare	++	++	
1.3	Efficient and responsible <b>use of information processing tools,</b> to support healthcare professionals' practice and their decision making	++	++	
1.4	<b>Use of personal application software</b> for documentation, personal communication including Internet access, for publication and basic statistics	++	++	
1.5	<b>Information literacy:</b> library classification and systematic health related terminologies and their coding, literature retrieval methods, research methods and research paradigms	++	++	
1.6	Characteristics, functionalities and examples of <b>information systems</b> <b>in healthcare</b> (e.g. clinical information systems, primary care information systems, etc.)	+	+++	
1.7	Architectures of information systems in healthcare; approaches and standards for communication and cooperation and for interfacing and integration of component, architectural paradigms (e.g. service-oriented architectures)		++	
1.8	Management of information systems in healthcare (health information management, strategic and tactic information management, IT governance, IT service management, legal and regulatory issues)	+	++	
1.9	Characteristics, functionalities and examples of <b>information systems</b> <b>to support patients and the public</b> (e.g. patient-oriented information system architectures and applications, personal health records, sensor- enhanced information systems)	+	++	
1.10	Methods and approaches to <b>regional networking and shared care</b> (eHealth, health telematics applications and inter-organizational information exchange)	+	++	
1.11	Appropriate documentation and <b>health data management principles</b> including ability to use <b>health and medical coding systems</b> , construction of health and medical coding systems	+	+++	
1.12	Structure, design and analysis principles of the <b>health record</b> including notions of data quality, minimum data sets, architecture and general applications of the electronic patient record/electronic health record	+	+++	
1.13	Socio-organizational and socio-technical issues, including workflow/process modelling and reorganization	+	++	
1.14	Principles of <b>data representation and data analysis</b> using primary and secondary data sources, principles of data mining, data warehouses, knowledge management	+	++	
1.15	Biomedical modelling and simulation		+	
1.16	<b>Ethical and security issues including</b> accountability of healthcare providers and managers and BMHI specialists and the confidentiality, privacy and security of patient data	+	++	
1.17	Nomenclatures, vocabularies, terminologies, ontologies and taxonomies in BMHI	+	++	
1.18	Informatics methods and tools to <b>support education</b> (incl. flexible and distance learning), use of relevant educational technologies, incl. Internet and WWW		+	
1.19	<b>Evaluation and assessment</b> of information systems, including study design, selection and triangulation of (quantitative and qualitative)		++	

### APPENDIX 4: IMIA'S EDUCATIONAL RECOMMENDATIONS

methods, outcome and impact evaluation, economic evaluation, unintended consequences, systematic reviews and meta-analysis,

evidence-based health informatics

#### IMIA'S EDUCATIONAL RECOMMENDATIONS CONTINUED:

2. M	2. Medicine, Health and Biosciences, Health System Organisation				
	Knowledge or Skill Domain	IT User	BMHI Specialist		
2.1	Fundamentals of <b>human functioning</b> and biosciences (anatomy, physiology, microbiology, genomics, and clinical disciplines such as internal medicine, surgery, etc.)	+	+		
2.2	Fundamentals of <b>what constitutes health</b> , from physiological, sociological, psychological, nutritional, emotional, environmental, cultural, spiritual perspectives and its assessment	+	+		
2.3	Principles of <b>clinical/medical decision making</b> and diagnostic and therapeutic strategies	+	++		
2.4	<b>Organisation of health institutions</b> and of the overall health system, interorganizational aspects, shared care	+	+++		
2.5	<b>Policy and regulatory frameworks</b> for information handling in healthcare		+		
2.6	Principles of <b>evidence-based practice</b> (evidence-based medicine, evidence-based nursing,)	+	+		
2.7	<b>Health administration, health economics,</b> health quality management and resource management, patient safety initiatives, public health services and outcome measurement	+	++		

Recommended and optional learning outcomes in terms of levels of

knowledge and skills for healthcare professionals in either in their role as IT

users or as BMHI specialists Recommended knowledge and skills level: + =

introductory. ++ = intermediate. +++ = advanced.

3. Inf	3. Informatics/Computer Science, Mathematics, Biometry				
	Knowledge or Skill Domain	IT	BMHI		
		User	Specialist		
3.1	Basic informatics terminology like data, information, knowledge,	+	+++		
	hardware, software, computer, networks, information systems,				
	information systems management				
3.2	Ability to use personal computers, text processing and spread sheet	++	+++		
	software, easy-to-use database management systems				
3.3	Ability to communicate electronically, including electronic data	++	+++		
	exchange, with other healthcare professionals, internet/intranet use				
3.4	Methods of <b>practical informatics</b> /computer science, especially on		+++		
	programming languages, software engineering, data structures, database				
	management systems, information and system modelling tools,				
	information systems theory and practice, knowledge engineering,				
	(concept) representation and acquisition, software architectures				
3.5	Methods of <b>theoretical informatics</b> /computer science, e.g. complexity		++		
	theory, encryption/security				
3.6	Methods of <b>technical informatics</b> /computer science, e.g. network		++		
	architectures and topologies, telecommunications, wireless technology,				
	virtual reality, multimedia				
3.7	Methods of interfacing and integration of information system		++		
	components in healthcare, interfacing standards, dealing with multiple				
	patient identifiers				
3.8	Handling of the <b>information system life cycle</b> : analysis, requirement	+	+++		
	specification, implementation and/or selection of information systems,				
	risk management, user training				
3.9	Methods of project management and change management (i.e.	+	+++		

3. Informatics/Computer Science, Mathematics, Biometry				
	Knowledge or Skill Domain	IT User	BMHI Specialist	
	project planning, resource management, team management, conflict management, collaboration and motivation, change theories, change strategies)			
3.10	<b>Mathematics:</b> algebra, analysis, logic, numerical mathematics, probability theory and statistics, cryptography		++	
3.11	<b>Biometry, epidemiology,</b> and <b>health research methods</b> , including study design		++	
3.12	Methods for <b>decision support</b> and their application to patient management, acquisition, representation and engineering of medical knowledge; construction and use of clinical pathways and guidelines	+	+++	
3.13	Basic concepts and applications of <b>ubiquitous computing</b> (e.g. pervasive, sensor-based and ambient technologies in healthcare, health enabling technologies, ubiquitous health systems and ambient assisted-living)		+	
3.14	Usability engineering, <b>human-computer interaction</b> , usability evaluation, cognitive aspects of information processing		++	

Recommended and optional learning outcomes in terms of levels of knowledge and skills for healthcare professionals in either in their role as IT users or as BMHI specialists Recommended knowledge and skills level: + = introductory. ++ = intermediate. +++ = advanced.

4. Optional Modules in BHMI and from Related Fields				
	Knowledge or Skill Domain		BMHI	
		User	Specialist	
4.1	Biomedical imaging and signal processing		+ - +++	
4.2	Clinical/Medical bioinformatics and computational biology		+ - +++	
4.3	Health-enabling technologies, ubiquitous health systems and		+ - +++	
	ambient-assisted living			
4.4	Health information sciences		+ - +++	
4.5	Medical chemoinformatics		+ - +++	
4.6	Medical nanoinformatics		+ - +++	
4.7	Medical robotics		+ - +++	
4.8	Public health informatics		+ - +++	

Table 14: Recommended and optional learning outcomes in terms of levels of knowledge and skills for healthcare professionals in either in their role as IT users or as BMHI specialists Recommended knowledge and skills level: + = introductory. ++ = intermediate. +++ = advanced. Source - (Mantas, Ammenwerth et al. 2010)

## APPENDIX 5: DETAILED AMIA 10 X 10 TRAINING PROGRAMME

1. Overview of discipline and its history	2. Biomedical computing
1.1. A discipline whose time has come	2.1. Types of computers
1.2. The discipline of biomedical informatics	2.2. Data storage in computers
1.3. Problems in health and biomedicine	2.3. Computer hardware and software
motivating biomedical informatics	2.4. Computer networks
1.4 Seminal documents and reports	2.5. Software engineering
1.5 Decourses of field	2.5. Challenges for bismedical commuting
1.5. Resources of field	2.6. Chanenges for bioinedical computing
3. Electronic nearth records	4. Decision support and nearthcare quanty
	4.1. Historical perspectives and approaches
3.2. History and perspective of the health	4.2. Healthcare quality
(medical) record	4.3. Medical errors and patient safety
3.3. Potential benefits of the electronic	4.4. Approaches to improving quality and
health record	safety
3.4. Definitions and key attributes of the	4.5. Reminders and alerts
HFR	4.6 Computerized provider order entry
3.5 FHR examples	(CPOF)
2.6 Current status of the EUD	(CIOL)
2.7 Health information analysis	
5.7. Health informatics exchange	
5. Standards, privacy and security; costs and	6. Evidence-based medicine and medical
implementation	decision-making
5.1. Standards: basic concepts	6.1. Definitions and application of EBM
5.2. Identifier and transaction standards	6.2. Interventions
5.3. Message exchange standards	6.3. Diagnosis
5.4. Terminology standards	6.4. Harm and prognosis
5.5. Privacy, confidentiality and security: basic	6.5. Summarizing evidence
concepts	6.6 Putting evidence into practice
5.6 HIPAA privacy and security regulations	6.7 Limitations of FBM
5.7 Cost bonefit of the EUD	0.7. Emilations of EDM
J.7. COST-Delient of the Link	
5.8 Implementing the EUP	
5.8. Implementing the EHR	
<ul><li>5.8. Implementing the EHR</li><li>7. Information retrieval and digital libraries</li><li>7.1. Leformation retrieval</li></ul>	8. Bioinformatics
<ul> <li>5.8. Implementing the EHR</li> <li>7. Information retrieval and digital libraries</li> <li>7.1. Information retrieval</li> <li>7.2. We take the label of the state of</li></ul>	8. Bioinformatics 8.1. Overview of basic molecular biology
<ul> <li>5.8. Implementing the EHR</li> <li>7. Information retrieval and digital libraries</li> <li>7.1. Information retrieval</li> <li>7.2. Knowledge-based information</li> </ul>	<ul> <li>8. Bioinformatics</li> <li>8.1. Overview of basic molecular biology</li> <li>8.2. Important biotechnologies driving</li> </ul>
<ul> <li>5.8. Implementing the EHR</li> <li>7. Information retrieval and digital libraries</li> <li>7.1. Information retrieval</li> <li>7.2. Knowledge-based information</li> <li>7.3. Content</li> </ul>	<ul> <li>8. Bioinformatics</li> <li>8.1. Overview of basic molecular biology</li> <li>8.2. Important biotechnologies driving bioinformatics</li> </ul>
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**Table 15:** 10 x 10 Health Informatics Training Programme organised byAIMA and AHIMA – Source (Hersh and Williamson 2007)

# APPENDIX 6: OVERVIEW OF NATIONAL REGULATIONS ON THE NUMBER OF LEARNING HOURS PER ACADEMIC YEAR

Countries	Hours range/ academic year	Hours range/ credit	Status of the proclamation
Austria	1,500 h	25 h	Law
Belgium (Fl)	1,500/1,800 h	25/30 h	Decree (law on the Flemish level)
Belgium (Fr)	1440 h	24 h	Decree(law of the French Community)
Czech Re-public	1,500/1800 h	25/30 h	Good practice, recommendation of ECTS Key Features.
Cyprus	1500h/1800 h	25/30 h	New Law for Higher Education (under consideration in 2008)
Denmark	1,650 h	27/28 h	Letters from the Ministry
Estonia	1,560 h	26 h	University Act law
Finland	1,600 h	27 h	Act of the Council of State
France	1,650 h	25/30 h	Recommendation by the University Presidents' conference
Germany	1,800 h	30 h	KMK (Kultusministerkonferenz = Standing Conference of the Ministers of the Federal States). Element of Accreditation
Greece	1,500/1,800 h	25/30 h	Ministerial Decision
Hungary	1,620/1,800 h	30 h	Act on Higher Education and attaching Governmental Decree
Iceland	1,500/2,000 h	25/33 h	No proclamation, but understanding among universities
Ireland		20/30 h	Recommendation on the principles and operational guidelines devised by the National Qualifications Authority of Ireland
Italy	1,500 h	25 h	Ministerial Decrees
Latvia	1,600 h		Law
Lithuania	1,600 h		Law and Decree
Malta	1,500 h	25 h	In Educational Act, 2004 and subsidiary legislation

Countries	Hours range/ academic year	Hours range/ credit	Status of the proclamation
Netherlands	1,680 h	28 h	Law
Portugal	1,500/1,680 h	25/28 h	Decree 42/2005 of 22 February.
Norway	no range per academic year proclaimed/ decision of universities	no range per credit proclaime d	Law
Poland	1,500/1,800 h	25/30 h	Decree
Romania	1,520/1,640 h	25/27 h	Order of the Ministry of Education (from 1999)
Slovakia	no range per academic year proclaimed	25/30 h	Good practice, recommendation of ECTS key features
Slovenia	1,500/1,800 h	25/30 h	Law (2004)
Spain	1,500/1,800 h	25/30 h	Royal Decree (law)
Sweden	1,600 h	26/27 h	Higher education ordinance (Government regulation) states full time studies during 40 weeks
Switzerland	1,500/1,800 h	25/30 h	Swiss University Conference (SUC) Regulation for the implementation of Bologna
Turkey	1,500/1,800 h		Law
United Kingdom	1,200-1,800 h	20 h	national Qualification (and Credits) Frameworks

**Table 16**: Overview of national regulations on the number of learning hoursper academic year – Source (ECTS 2009)

#### **APPENDIX 7: STRUCTURED INTERVIEW RESEARCH QUESTIONS**

- 1. What were the drivers / reasons behind setting up of your HI unit
- 2. How do you arrive at the objective, aims and goals for establishing such a unit?
- 3. What are the protocols and polices involved in establishing the unit
- 4. How do you go about identify stakeholder and project champions
- 5. What are the challenges to be considered
- 6. What areas of Health Informatics did you focus on (initially and currently)?
- 7. What were the reasons of focusing on such area (above)?
- 8. What is the duration of the programme and has it changed since?
- 9. What factors did you consider when designing the curriculum programme structure?
- 10. How do you differ from other Health Informatics schools?
- 11. What worked successfully from your initial plans in setting up the HI Unit
- 12. What would you do different if you were to do this again?
- 13. Have you any form of collaborations with any other institutions which are conducting a similar course (if so, why and if not, why)?
- 14. How about collaboration (or involvement) of health institutions?
- **15.** Where does the informatics unit seat in the academic organisational structure
- 16. What other groups did you work with within the organisational setting and what were the reasons?
- **17.** How are you funded, how do you obtain support and any other cost issues to consider
- 18. How do you arrange for administration and teaching resources?
- 19. What are the benefits and challenges of running this programme? Any other comments you feel should be addressed.

**Table 17:** Structured Sample Questionnaire used in the Interviews

# **APPENDIX 8: SAMPLE TITLES OF REVIEWS LITERATURE**

• 1065-how-ugandas-health-care-problems-can-end-with-a-phone.pdf	HIS Strategic Planning Process Guidance_ 2009 March 3.pdf
• A benchmarking study on information management systems.pdf	• HIS Reform in SA - Developing an essential Data set.pdf
Accessing Computer Skill in Tanzania.pdf	HIS Past Present and Future.pdf
aims and tasks of Medical Informatics.pdf	HSSP_III_2010.pdf
Alliance HPSR IPRQ_Makere_Report.pdf	HS ICT Policy _Final Drft_050906[1].doc
An Approach to Policy Analysis and Development of Medical Informatics.pdf	• Hovenga_2004_Globalisation of health and medical informatics educ.pdf
• An international course on strategic information in MHI.pdf	Human Resources for Health.pdf
• An international summer school on health informatics.pdf	ICT4MPOWER Executive Summary 1.0.pdf
• Bakker_2002_Healthcare and ICT partnership is a must.pdf	• Implementing a new HMIS in Uganda.pdf
Biomedical informatics training at Stanford.pdf	Improving Imperfect Data from HIMS.pdf
Building HMIS in Egypt.pdf	International perspectives and initiatives.pdf
Burgun_2006_Problem-based learning in medical informatics.pdf	• IT and Challenges of Economic Development in Africa.pdf
• Building collaborative networks in Africa on health information systems.pdf	<ul> <li>Jaspers_2007_The new set-up of the medical informatics MSc.pdf</li> </ul>
• ccs_uganda_2009_2014.pdf	<ul> <li>Joint WHO \342\200\223 CDC Conference on LIS.pdf</li> </ul>
Challenges to EHR Implementation in Electronic- Versus.pdf	<ul> <li>MAK_proposed-college-computing-college_revised.pdf</li> </ul>
<ul> <li>Chiasson_2007_Expanding multi-disciplinary approaches to Hi Tech.pdf</li> </ul>	• Leven_2004_Medical informatics at Heidelberg Heilbronn.pdf
Consumer Health Informatics.pdf	Master of science program in health information.pdf
define informatics and health information technology.pdf	Medical Informatics in Medical Research.pdf
Developing HIS in Zanzibar.pdf	Medical informatics Past present future.pdf
Distributed health informatics graduate education for.pdf	millennium development goals, Uganda Country profile.pdf
Education training and development of HI.pdf	National Development Plan Uganda 2010-2015.pdf

Evaluating Computerised HIS.pdf	NOMA Annual Report 2009pdf
Evaluation of DHIS in Rural SA.pdf	NORD Prog for Masters.pdf
• Evaluation of Implementation of BSc IT curriculum at Tumaini University.pdf	Power Tension in HIS Integration in Developing Countries.pdf
• Evaluation of distance learning delivery of HIM.pdf	Problems to create oppotunities.pdf
• Experience of privately sponsored studentship.pdf	Public Expenditure, Growth and Poverty.pdf
• Fee Hick in Makerere.pdf	Recommendations of IMIA.pdf
• Friedman_2003_Is medical informatics a mature science.pdf	Regulatory innovations in TZ.pdf
• Funding agencies in low- and middle-income countries.pdf	Review id the TZ-Norway NUFU program.pdf
Govt_Expenditure_Uganda.pdf	Research needs and priorities in health informatics.pdf
Haux_2004_Biomedical and health informatics education at.pdf	• Rejection of an innovation HIM training material in EA.pdf
Haux_2006_HIS past present future.pdf	Standardization in health informatics in Canada.pdf
Haux_2006_Individualization globalization and health sustain.pdf	• Strategies for Developing HR Capacity Support - Tanzania.pdf
Haux_2010_Medical informatics Past present future.pdf	Sustainable Development of Medical Informatics in Africa.pdf
Healthcare in Africa.pdf	The Case for a National Health Information System     Architecture.pdf
Health Challenges in Africa_1.pdf	• The future of health informatics.pdf
Health informatics current challenges.pdf	The IMIA Strategic Plan - Towards IMIA 2015.pdf
Health informatics meet eHealth.pdf	• WHO_HIS.pdf
HEALTH INFORMATION SYSTEMS.pdf	• The School of HI Sci in Uni of Victoria.pdf
Health Research Funding Agencies Support.pdf	• Uganda_WHO.pdf
Health_management IS.pdf	Utilization of aid in developing countries.pdf
Hersh_2006_Journal-of-the-American-Medical-Informatics- Association.hta	• The new set-up of the medical informatics Master of Science program.pdf
HIS Development Egypt Phase 1.pdf	

 Table 18: Sample Titles of Journals and publications reviewed for the study



### **APPENDIX 9: SAMPLE HEALTH INFORMATICS ACADEMIC PROGRAMME**

Figure 16: An overview of the Heidelberg/Heilbronn Masters of Science Health Informatics Management curriculum including the major subject areas and course content, which may be held on a weekly basis or as block courses - Source: Adopted from (Haux and Schmidt 2002; Leven, Knaup et al. 2004)

## APPENDIX 10: COLLEGE OF COMPUTING AND INFORMATICS SCIENCE STRUCTURE



Figure 17: Structure for Makerere University College of Computing and Informatics technology, including course offered – (Information extracted from MUK College of Health Science Website – (COCIS-Web 2011)- 15/02/11)



APPENDIX 11: COLLEGE OF HEALTH SCIENCE STRUCTURE

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**APPENDIX 12: MAKERERE UNIVERSITY ACADEMIC GOVERNING STRUCTURE** 

Figure 19: Describes Makerere University Governing Structure, which highlights relevant committees and memberships. Source: Adopted from (MUK-Web 2011)

# APPENDIX 13: SITUATION ANALYSIS SAMPLES TO SUPPORT MOTIVATION & JUSTIFICATION

#### Situation Analysis I: Health Informatics Data Use

Since 2009, the Uganda's Ministry of Health holds annual workshops on the awareness of health informatics systems, which is aimed at bringing together all health informatics stakeholders around the country to meet, share and discuss various aspects associated to the management of health informatics data.

Discussions on these workshops always revolve around the challenges and also success stories related in the collection of health informatics data, electronic data entry and aggregation, transmission of collected informatics within the health facilities, harmonisation of existing systems, interoperability related issues and the way forwards leading to an integrated National Health Informatics System.

These workshops concentrate mainly on:

- Increased awareness about the National Health Informatics System (NHIS), including the guidelines which govern its usage, to the health informatics managers as well as the international supporting partners
- Developing and strengthening the monitoring, reporting and evaluation strategies which will be utilised in the planning and making decision on the best ways of capturing evidence-based data
- Reinforcing the need for the use of appropriate and sustainable health informatics systems programmes' activity backbone.

This year's workshop, which was held on June  $14^{th} - 16^{th}$  2011, was aimed at three main outcomes namely, Situation Analysis, Description of Challenges and Recommendations on the way forward on a list of twelve targeted areas as listed in the table below.

•	Health Management Informatics Systems data collection and management	•	Electronic Health Management Informatics Systems including District HIS2
•	Monitoring and Evaluation	•	Innovative Solutions
•	Medicines, Supplies and Laboratory Systems	•	Data use at patient, community and facility level
•	Patient Monitoring Systems	•	Data use at policy level
•	Planning of District Health Management Informatics Systems	•	Data dissemination
•	Reporting Burden	•	Advocacy of Data use

**Table 19**: Some of the Issues debated about on the June  $14 - 16\ 2011$  healthData User Workshop, which highlights some of the health sector'sinformation needs.

#### Situation Analysis II: eHealth Stakeholder Workshop:

According to SCW (2011), Uganda's Ministry of Health in collaboration with the Commonwealth Secretariat, London convened an eHealth Stakeholders Workshop in Kampala on the 2 - 4 of May 2011. This workshop was aimed raising awareness of the best options and strategies for improving coordinated country owned health informatics systems amongst all key stakeholders, and key objectives included:

- The review of existing eHealth policy documents in order to harmonise and develop a common integrated national eHealth policy document, from the identify gaps
- Discussion and eliciting of participant's views and opinions on the development of the National eHealth Strategy and Architecture
- Recording of participants' commitment to lead and champion the execution of multi-sectoral action plans resulting from the eHealth Strategy.

The Workshop brought together more than forty participants from Ministries of Health, Information Communication Technology, Local Government, Finance, Planning and Economic Development, Public Service, National Planning Authority, Makerere University, Kampala, senior officials from District Health Services, Development Partners and representatives of private sector ICT providers (SCW, 2011).

#### Situation Analysts III: Resource Centre Vision Framework 2012:

In 2009, the Ministry of Health developed and drafted a comprehensive strategic response through the "Resource Centre's Vision 2012 framework", through consultation with various MOH-U technical departments, programmes, government institutions, development partners and non-governmental stakeholders.

VISION (2012) addressed a number of health informatics challenges and needs which have a great impact on the current health sector's service delivery such as:

• Data Collection mechanisms and policies

- Interoperability and scalability of existing health informatics systems
- Easy of uses of data tools by frontline health workers
- How duplication and redundancy of information systems and services could be avoided
- The cost effectiveness and efficiency of implemented systems and data tools
- How the quality of data captured should be timely, complete, reliable
- The need for integrating of existing systems with new developed systems

In reaction to some of the challenges listed above, Vision (2012) stakeholders formulated the following strategic visions, which included:

- 1) Improving the timeliness, accuracy, completeness, reliability, value, access and use of health informatics by establishing policies and procedures that promote interoperable harmonized health and health related data collection, analysis and use at national, district, facility, and community levels
- 2) Ensuring the availability of accurate, timely and complete information upon which policy formulation, resource allocation and decision-making at different levels of the health system are based
- Improving healthcare services provided to health clients by developing and implementing national client identifier and medical record and use at community, facility, district and national levels
- 4) To build sustainable capacity by equipping various levels of the health system with appropriate, reliable, fast, and cost-effective data collection, storage, analysis, communication tools and to develop human resources with the necessary skills.

#### Situation Analysis IV: East African Information Forum:

According to COSLF (2009), the "Country Ownership Strategies: Leadership Forum on Health Informatics Systems" is a forum which was set up by USAID in collaboration with WHO and the World Bank to capitalize on such ongoing initiatives by proposing ways of accelerating the development and implementation of country-owned strategies for strengthening Health Informatics Systems in seven focal countries of East and Southern Africa (Eritrea, Ethiopia, Kenya, Malawi, Rwanda, Tanzania, and Uganda).

The objectives of this forum were to:

- Develop a shared awareness of the best options and strategies for improving coordinated country HIS
- Establish a common policy agenda and strategy to improve country HIS
- Support and strengthen country teams as catalysts for promoting country ownership of HIS
- Provide participants with information and access to financial and technical assistance from national and international partners committed to supporting country-level HIS strengthening

Some of the issues discussed in this forum included seeking means of how to:

- Serve better the needs of the people of Uganda and participate globally in ensuring the safety and security of the people
- Allow for proper visibility for results to ensure financial support for critical health needs
- Creation of a functional and accessible one stop centre repository with minimum National data sets that is linked to the national Statistical Data Bank
- Leveraging resources
- Increased use of data and information
- Avoid duplication and Ensure quality control
- Promotion of standards to allow for interoperability
- Ensure strong networking among stakeholders
- Improved visibility and value of HIS at the highest level in the organisations
- Streamlined information flow and Institutional Framework
- Evidence-based decision at all levels
- HIS Policy ( Data security and access), Vision 2012, Mission and Strategy to ensure proper accountability, transparency and
- Focus on improving supply management for drugs and equipment
- Improved behaviour change in demanding and use of information.