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Health Informatics: Developing a Masters Programme in Rwanda based on the IMIA Educational Recommendations and the IMIA Knowledge Base

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Abstract

Since 2011, the Regional e-Health Center of Excellence in Rwanda (REHCE) has run an MSc in Health Informatics programme (MSc HI). A programme review was commissioned in February 2014 after 2 cohorts of students completed the post-graduate certificate and diploma courses and most students had started preparatory activity for their master dissertation.

The review developed a method for mapping course content on health informatics competences and knowledge units. Also the review identified and measured knowledge gaps and content redundancy. Using this method, we analyzed regulatory and programme documents combined with stakeholder interviews, and demonstrated that the existing MSc HI curriculum did not completely address the needs of the Rwandan health sector. Teaching strategies did not always match students' expectations. Based on a detailed Rwandan health informatics needs assessment, International Medical Informatics Association (IMIA)'s Recommendations on Education in Biomedical and Health Informatics and the IMIA Health Informatics Knowledge Base, a new curriculum was developed and provided a better competences match for the specifics of healthcare in the Central African region. The new approved curriculum will be implemented in the 2014/2015 academic year and options for regional extension of the programme to Eastern DRC (Bukavu) and Burundi (Bujumbura) are being investigated.

Keywords:

Education; Medical Graduate; Teaching; Curriculum; Knowledge.

Introduction

The International Medical Informatics Association (IMIA) is the international organization for health and biomedical informatics. IMIA acts as a bridging organisation, bringing together the constituent regional and country health informatics associations and their members. The IMIA General Assembly has approved a number of endorsed documents:

1. Recommendations of the International Medical Informatics Association (IMIA) on Education in Biomedical and Health Informatics; First Revision (2010)
2. IMIA Knowledge Base (2011)

The Recommendations of the IMIA on Education (1)

Rather than reproduce all the recommendations, the first 6 illustrate the nature of the recommendations:

Biomedical and Health Informatics Core Knowledge and Skills

1.1 **Evolution of informatics** as a discipline and as a profession

1.2 **Need for systematic information processing** in health care, benefits and constraints of information technology in health care

1.3 Efficient and responsible **use of information processing tools**, to support health care professionals' practice and their decision making

1.4 **Use of personal application software** for documentation, personal communication including Internet access, for publication and basic statistics

1.5 **Information literacy**: 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 **information systems in health care** (e.g. clinical information systems, primary care information systems, etc.)

The IMIA Knowledge Base (2-4)

In 2011, IMIA also published a knowledge base structuring the knowledge of the Health Informatics domain into 14 topics (listed below). The base was subdivided into 245 knowledge units. This unit list served in the review process as a tool for measuring the coverage of Health Informatics knowledge by the MSc HI curriculum:

1. Computer Science for Health Informatics (ICT for Health)
2. Health & Social Care Processes
3. Health (care) Records
4. Health and Social Care Industry
5. Health Informatics Standards
6. Knowledge Domains and Knowledge Discovery
7. Legal and Ethical
8. People in Organisations
9. Politics and Policy
10. Technologies for Health
11. Terminology, Classification and Grouping
12. Uses of Clinical Information
13. Using Informatics to Support Clinical Healthcare Governance
14. Computer Systems Applications in Health (Toolkit)

Figure 1 – Section of the IMIA Knowledge Base

In February 2014 in Kigali with a team of 3 international reviewers, the University of Rwanda, College of Medicine and Health Sciences (CMHS) commissioned a curriculum review of the MSc in Health Informatics (MSc HI) programme. The team used an Action Research method to review and rewrite the curriculum based on the two IMIA endorsed documents above.

The review activities consisted of:

- A study of national regulations and documents relevant for the MSc HI programme.
- A study of the MSc HI programme documents.
- A study of international standards, recommendations and literature on health informatics postgraduate education programmes (6,7) especially those that had been endorsed by the IMIA.
- A mapping of the existing MSc HI curriculum content on to international standards and regulations.
- A field study of needs and competences in Rwanda in the area of health informatics (5), mainly through a number of interviews with relevant stakeholders, including Ministry of Health (MoH) staff, NGOs, public and private health facilities, education & training institutions, health software development companies and research organisations.
- An evaluation of how students, teaching staff and CMHS faculty perceived the existing MSc HI curriculum.

Information obtained from the MoH clearly showed a growing need for people with combined skills covering Information Technologies (IT), Information Systems (IS), Information Management (IM) and Health System (HS) knowledge. Generally speaking, there is a shift from IT and IS towards IM and HS needs: internal MoH software and systems development activities are progressively phasing out in favour of private sector outsourcing. Consequently, the MoH requires new management skills related to contracting, people management, and project management. Health facilities identified competences related to health care research (mainly for university teaching hospitals), data mining, and statistical and epidemiological reporting based on Electronic Health Record (EHR) content. Public and private hospitals described the urgent need for Chief Information Officer (CIO) profiles that again must be capable of combining IT, IS and IM knowledge and skills.

Based on competence needs and employment perspectives, the following human resource profiles can be identified for MSc HI graduates:

- Health Information Managers (mainly IM and HS knowledge and skills needed in public sector)
- Clinicians proficient in IT, IS and IM (health facilities)
- Information System Implementers and System Integrators (e.g. for EMR-HMIS integration)
- Information System Evaluators (Health Informatics Interventions impact measurement and Information Systems quality evaluation)
- Education staff (Academic staff and Information Systems training staff / functional experts)
- Researchers (Health Informatics domain and other Health Care domains)

All of the competences identified by the Rwandan stakeholders were covered by the IMIA recommendations on Education.

Methods

The IMIA recommendations were mapped to the IMIA Knowledge Base and the learning outcomes produced would underpin the identified human resource profiles. This mapping then lead the team to develop an SQL database.

IMIA competences - knowledge base mapping

In the first exercise, 40 competences identified in the "IMIA recommendations for health informatics education" were mapped on 0 or more knowledge units in the IMIA knowledge base. This resulted in a total of 400 mappings, clearly demonstrating the IMIA Knowledge Base units synergy with the IMIA competences.

IMIA competences - existing programme mapping

Each module title of the existing MSc HI programme was then mapped onto a number of IMIA competences (replacing the original programme objectives). This showed that a total set of 38 IMIA competences (out of 40) were covered by the existing programme. The existing programme modules did not have consistency within or between modules in terms of content. There were gaps in the content and poorly distributed weightings of the content. However, the module titles and objectives gave a good starting point to automatically populate these modules using the IMIA recommendations and the IMIA Knowledge Base. The computer based exercises took 5 days using a three dimensional SQL Querying method devised by Dr. Verbeke.

IMIA knowledge - existing curriculum mapping

Based on the mapping between existing MSc HI module titles and IMIA competences combined with the previously performed mapping between IMIA competences and IMIA knowledge units, an automatic mapping between existing MSc HI modules and IMIA knowledge units was generated. This demonstrated that 219 (out of 245) knowledge units were covered by the existing titles and structure.

Development of a reference curriculum

The automatically generated mapping table between existing curriculum modules and IMIA knowledge units was then cleaned for redundancy (assigning each knowledge unit to only one single module) and for completeness (modifying module content in order to cover previously missed knowledge units). This provided a set of modules with 100% knowledge coverage whilst avoiding any redundant or repetative teaching.

In a final phase, a number of modules were (partially) merged in order to come to an equally distributed module weight of 10

credits for each module, with 6 modules in the post-graduate certificate year and 6 modules in the post-graduate diploma year.

Results

An Example of Module Aims, Outcomes and Content Introduction to Health Informatics

Brief description of aims and content

This module introduces the discipline of health informatics and the details of the programme. The module covers a number of basic concepts in health informatics and ensures that students from different backgrounds have the opportunity to share perceptions of health and medical informatics.

Learning outcomes (competences) from IMIA Recommendations

1.1 Evolution of informatics as a discipline and as a profession

1.4 Use of personal application software for documentation, personal communication including

Internet access, for publication and basic statistics

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 spreadsheet software, easy-to-use database management systems

3.3 Ability to communicate electronically, including electronic data exchange, with other health care professionals, Internet /intranet use

3.4 Methods of practical informatics/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

3.6 Methods of technical informatics/computer science, e.g., network architectures and topologies, telecommunications, wireless technology, virtual reality, multimedia

Indicative content (units) from IMIA Knowledge Base

- Access to information
- Computer literacy (ECDL)
- Computer systems
- Computing methodologies
- Data management and storage
- Databases
- Demystify IT for users
- Explains health informatics
- History of methods of gathering information in the clinical workplace
- Human Computer Interaction (HCI) principles
- Information sources
- Information Storage and Retrieval
- Internet, intranets and associative technologies
- Networking
- Web technologies
- Wireless technology
- Prototype system for a department

The curriculum content was also weighted according to the recommended student workload in European Credit Transfer and Accumulation System (ECTS) credits for the knowledge and skill areas of a two year biomedical and health informatics master (BMHI) programmme.

Table 1 - European Credit Transfer and Accumulation System (ECTS) credits

Knowledge/Skill Area	Credits
1. BMHI Core Knowledge And Skills	80
2. Medicine, Health And Biosciences, Health System Organisation	20
3. Informatics/Computer Science, Mathematics, Biometry	40
Total ECTS credits	120

The teaching components of the programme total 120 credits. These components are divided between the Certificate and Diploma levels. However the number of ECTS recommended by the IMIA team are 140; therefore, 20 of the credits will be included in the Research Thesis.

Post-graduate certificate

The post-graduate certificate programme essentially focuses on IT and IS after an introduction to the Health Informatics domain. The development of practical skills and essential knowledge of the Rwandan health informatics context are core components of the programme.

Introduction to Health Informatics: includes an introduction to the discipline of Health Informatics and the scope of the programme. The course covers a number of basic concepts in Health Informatics and ensures that the students have the opportunity to share perceptions of Health and Medical Informatics (8).

Healthcare Management and Organisation: covers the concepts of Healthcare Management in relation to Health Informatics. The Health Informatics concepts underpinning management, organisational culture and socio-technical aspects are explored (8).

Knowledge Management in Healthcare Delivery: covers Health Informatics topics, in particular the processing of Data into Information, and then into Knowledge. The use of this knowledge is explored in Decision Making and Education.

Management Information Systems: explores the connection between information systems (IS) and business performance. It also explores the issues of security, transparency, traceability and Return on Investment.

Electronic Health Records Management and Hospital & Health Information Systems: assists students to understand the complexities of managing individual and community based health information. Students will be able to understand different approaches of health record modeling; purpose based structuring of health information and the principles of integrated health information management (9).

Health Informatics Applications including PACs, MIT, Telemedicine and mobile technologies: explores the concepts of ubiquitous computing technologies to provide positive support in the population. It explores the use of telemedicine and e-Health solutions for medical support. This is underpinned by an exploration of wireless technologies.

Post-graduate diploma

The post-graduate diploma year is designed to add more IM knowledge and skills, leading the student to a broader comprehension of the complete health informatics domain and its place in the health system ("the big picture"). It also adds

essential project management skills and elements of critical thinking enabling well-considered evaluation of different options. Research skills and scientific reasoning are formally included in the programme.

The following modules are part of the diploma programme:

Software Based Clinical Decision-making and Support Systems: explores the concepts of information to support health professionals in their decision-making and development of therapeutic strategies. The module covers clinical pathways and guidelines and biomedical modeling and simulation as well as the principles of data representation and cognitive aspects of information processing.

Public Health Informatics includes Patient Information Kiosks, Websites and Public Health Systems for Epidemiology, Epidemic Control and GIS: explores the concepts of data representation and information analysis. The module includes information tools to support education for the public and health professionals, epidemiology and public health.

Social-Cultural, Legal and Economic Impact of Health Informatics: explores ethical, legal, and social issues arising in the use of computer-based technology and information systems in the delivery of health care. The module also includes health informatics ethics and regulatory frameworks.

Project Management and IT Introduction in Health Care Delivery, Case Studies in Health Informatics: students learn the principles of project management and using information management within projects. Through exploration of health information projects, students gain a real-world understanding of how to manage biomedical informatics projects taking into account the socio-technical aspects of implementation.

Research, Monitoring and Evaluation in Health Informatics: explores an introduction to research in the areas of health informatics and covers a wide range of methods and techniques. The topics range from epidemiology data and analysis and mapping to measures of patient outcomes following medical interventions. Evaluation and monitoring of programs of care and clinical audit are also included (9).

E-health Enterprise Architecture: explores the details of healthcare information technology (HIT) interoperability and standards. The evolution of technology in healthcare, along with the impact on clinical information systems, is studied. The benefits of integrating healthcare information systems are investigated (9), as are the challenges of integrating systems across disparate organisations, healthcare disciplines, and technologies. The value proposition of a standards-based approach to integration is presented (10).

Discussion

This curriculum has been validated and plans to start in January 2015. The curriculum is the first in Africa to be based on the IMIA recommendations.

The new MSc HI programme has been tailored to the Central African context (8) and options for regional extension of the program to Eastern DRC (Bukavu) (10) and Burundi (Bujumbura) are being investigated.

Conclusion

The 3-dimensional mapping of IMIA competences, IMIA knowledge base units and curriculum module titles provided a useful method for validating biomedical and health informatics domain coverage of a competence based MSc HI curriculum in Rwanda. The same method could be applied to other MSc HI programmes seeking compliance with IMIA biomedical and health informatics education standards. Unfortunately there is insufficient space to include details of the SQL queries in this article. The authors intend to publish this in a technical paper.

Many of the content gaps found by our analysis might have been revealed earlier had more robust evaluation and monitoring processes been in place. In addition to the work discussed in this paper, the review also explored the teaching and assessment strategies employed. The programme content gaps and teaching strategy issues discovered during the curriculum review demonstrated the importance of periodical external curriculum reviews.

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