Developing Harmonized Benchmarks for the Master of Science in Health Informatics for the East African Region

Job Nyangena[a], Kimutai Some[b], Mike Kuria[c], Ann Nangulu[d], Simon Kasasa[e], Frances B. da Costa Vroom[f], Graham Wright[g], Martin C. Were[h]

[a]*Institute of Biomedical Informatics, Moi University, Eldoret, Kenya,*
[b]*Department of Engineering, University of Eldoret, Eldoret, Kenya*
[c]*Inter-University Council for East Africa, Kampala, Uganda*
[d]*Department of History, Political Science and Public Administration, Moi University, Eldoret, Kenya*
[e]*Department of Epidemiology & Biostatistics, Makerere University, Kampala, Uganda*
[f]*Department of Biostatistics, University of Ghana, Accra, Ghana*
[g]*Visiting Professor, Rhodes University, Grahamstown, South Africa*
[h]*Department of Biomedical Informatics, Vanderbilt University Medical Center, Nashville, TN, USA*

Abstract

Higher education institutions in low- and middle-income countries are increasingly offering post-graduate degree programmes in health informatics. An analysis of accredited Master of Science in Health Informatics (MSc HI) programmes in the East African Community (EAC), a common higher education and labor zone, revealed wide variability in covered courses and competencies. In this paper, we describe the process undertaken to harmonize and establish common benchmarks for MSc HI for the EAC, in collaboration with the Inter-University Council for East Africa (IUCEA). After a multi-step process involving desk-reviews, benchmarking workshop with stakeholders, and quality assurance of benchmarks by IUCEA, the MSc HI benchmarks were finalized. These benchmarks outline the MSc HI degree programme goal, objectives, admission criteria, graduation requirements, and expected Learning Outcomes (ELOs). The ELOs are further translated into courses covering all identified skills and competencies. The benchmarks should facilitate mobility of students, faculty and labor, and improve program quality.

Keywords:

Graduate Education, Health Informatics, Competency-Based Education

Introduction

In response to the increasing demand for well-trained health informatics (HI) personnel, a growing number of institutions in low- and middle-income countries (LMICs) are offering degree programmes in the field. One of the most commonly offered academic programmes in these institutions is the Master of Science in Health Informatics (MSc HI) degree program. Unfortunately, existing MSc HI degree programmes exhibit wide variability in covered courses and competencies, with these differences likely to compound as more programmes are established. As an example, a comparison of seven of the eight accredited MSc HI programmes in the East African community (EAC, a common higher education and labor zone) revealed that the total number of courses covered ranged from 8 to 22, with a statistically significant difference in competency coverage across the seven institutions (p value = 0.012). A pair-wise university comparison of competencies covered in MSc HI programmes between the universities revealed that only 4 of 21 university-pairs (19%) met a cutoff of over 70% similarity in shared competencies.[1]

Significant variation in competencies covered within MSc HI degree programmes poses a risk to mobility of students, faculty and labor in LMICs. In fact, credibility of MSc HI degree programmes will be significantly threatened if graduates seeking employment present with widely variable competencies. A regionalized harmonized set of core competencies in MSc HI (named benchmarks) could alleviate variability concerns and provide quality control reference for existing and emerging programmes, while allowing room for institutions to distinguish themselves through delivery mechanisms and additional content they see fit for their programmes. This paper describes development of benchmarks for MSc HI degree programmes in the EAC, as a demonstration of efforts to improve quality of HI education in LMICs.

Methods

Setting

The EAC is composed of six countries, namely: Burundi, Kenya, Rwanda, South Sudan, United Republic of Tanzania, and Uganda. Ethiopia and Somalia participate in the community as observer countries or in regional projects, as is the case with the World Bank-supported Eastern and Southern African Centres of Excellence facilitated by IUCEA. The EAC is home to over 172 million people, over 300 universities, with approximately one million enrolled students.[2] Countries in the EAC make up a common economic, education and labor zone, which guides free mobility of students, faculty, workforce and services.[3]

The Inter-University Council for East Africa (IUCEA) is a strategic institution of the East African Community (EAC) responsible for developing and coordinating higher education and research programmes in the region. In 2006, the IUCEA initiated a process aimed at harmonizing regional quality assurance by establishing a common East African quality assurance framework.[4] One of the mandates of the IUCEA under this framework is to maintain high and comparable academic standards in higher education regionally and

internationally, with special emphasis on the promotion of quality assurance (QA) and quality management. The IUCEA has already supported development of several benchmarks for the EAC including Bachelors of: Business degree, Computer Science and Information Technology, Medicine, Agriculture, and Engineering. It is based on these experiences that the IUCEA worked with regional higher educational institutions (HEIs) to develop the benchmarks for MSc HI degree programmes for the region.

Benchmarks Objectives

The objectives of the formulated benchmarks were to:

1. Act as a guide and tool for HEIs designing or reviewing a curriculum for MSc HI programmes;

2. Enable the National Commissions and Councils for higher education to assess the quality of MSc HI programmes;

3. Promote harmonisation programmes in the region;

4. Support staff and student mobility;

5. Enhance regionalization of the labor market, which is one of the aims of the EAC;

6. Guide the labor market in evaluating the quality of graduates.

Benchmarks Approach

An evaluation of the similarities and differences between IUCEA-accredited MSc HI Programmes in the EAC informed the decision to develop the benchmarks.[1] In developing the benchmarks, consideration was placed on region-specific needs as informed by the comparative analysis of programmes, and by regional and institutional subject matter experts who participated in the benchmarks development process. Reference was also made to existing International Medical Informatics Association (IMIA) recommendations and knowledge-bases relevant to MSc HI.[5, 6] Further, Bloom's taxonomy was used in developing the expected learning outcomes (ELOs) for the overall programme and for individual courses, highlighting the knowledge, skills and attitudes expected of learners.

MSc HI Benchmarks Development Process

For benchmarks development, the IUCEA seeks to enhance and operationalise the Credit Accumulation and Transfer System (CATS) in the EAC Partner States and beyond. The key outcome of this exercise was the minimum standards (benchmarks) for the Master of Science in Health Informatics in the East African Region.

Development of the MSc HI benchmarks involved an iterative process as detailed below:

1. A letter was written to the IUCEA Executive Secretary to request assistance with the benchmarks development process.

2. The eight universities in East Africa with accredited and ongoing MSc HI Programmes were identified to participate in the process.

3. Deans and Heads of Departments (HoDs) of the identified institutions were contacted to inform them of the need for MSc HI benchmarks and request their participation in the exercise.

4. Other stakeholders were identified for participation, including representatives from the IMIA, the Pan-African Health Informatics Association (HELINA), Ministry of Health in Kenya, and private sector representatives.

5. A draft of the benchmarks for the MSc HI was then developed using the results from the curriculum review process, as well as other desk reviews and consultations with regional and international experts in MSc HI degree Programmes. These draft benchmarks were shared with the institutions for review prior to an in-person meeting.

6. To refine the draft benchmarks, a two-day Benchmarks Development meeting was held with the various stakeholders and institutional representatives on May 9th and 10th, 2019 in Nairobi, Kenya. Technical content for the MSc HI degree benchmarks were identified through a consensus-based mechanism by the involved experts and stakeholders.

7. The developed benchmarks were then submitted for review to IUCEA.

8. Reviewers' comments were addressed, and an in-person meeting was held between Mar 3 and 5, 2021 that included the IUCEA, the reviewers, and the technical MSc HI team to finalize the benchmarks.

Outputs

The output of the harmonisation and benchmarking process included an IUCEA-approved document that detailed several items, namely: MSc HI degree programme goal and objectives; admission criteria; graduation requirements and ELOs. The ELOs are further translated into courses that cover all identified relevant competencies during the development process.

Results

The harmonisation exercise resulted in a publication under the IUCEA entitled '*Benchmarks for the Master of Science in Health Informatics (Inter-University Council for East Africa [IUCEA], 2021).*' Below we provide key highlights of the resulting benchmarks according to the following higher-level themes: (a) Programme Goals, Objectives and Expected Learning Outcomes, (b) Admission criteria, (c) Course length; (d) Program structure and content; and (e) Graduation requirements.

Programme Goals, Objectives and Expected Learning Outcomes

The benchmarks identified the goal of the MSc HI degree programmes as that of producing graduates capable of using informatics in different health domains for acquisition of knowledge, research, improved health care and decision making. In developing the benchmarks, emphasis was placed on designing MSc HI programmes that addressed academic ability, employability, and personal development of the graduates. ELOs were defined for the program to: enhance students' learning and mobility; produce quality graduates; improve students' learning, retention, progression and completion rate; provide guidance to instructors; identify and overcome barriers to effective teaching/training; and increase students' chances for employability.

To harmonize the MSc HI programme and make it more coherent and consistent for East Africa, ELOs were formulated

for use as benchmarks – these ELOs provide a threshold that must be achieved by all graduates. The twelve overarching ELO's for the MSc HI programme are outlined in Table 1. In addition, each graduate also has to achieve course-specific ELOs. HEIs may consider adding ELOs when necessary in line with their mission and vision or other identified need(s).

Table 1 – Expected Learning Outcomes for MSc HI

I. Knowledge	1. Understand principles and theoretical underpinnings of health informatics in the various domains.
	2. Demonstrate the application of the principles of health informatics in diverse healthcare settings.
II. Skills	
a. Cognitive	3. Evaluate HIS and processes to improve healthcare.
	4. Analyze, use, and interpret data to improve healthcare-related decision making.
b. Practical	5. Develop information technology-based solutions for healthcare.
	6. Implement, evaluate, and iteratively improve health information systems.
	7. Demonstrate critical thinking, research ability, oral and written communication.
c. Interpersonal	8. Effectively work collaboratively with other experts within and across disciplines.
	9. Apply principles of informatics, through integration of community engagement, in different domains of health.
II. Attitudes	10. Participate in continuous professional development to keep up to date with the progress in the field.
	11. Provide leadership and collaborate in HI programmes at regional and global levels.
	12. Integrate ethical, legal, economic, health policy, multi-cultural and behavioral factors into the application and promotion of HI.

Admission criteria

Health Informatics (HI) is a discipline at the intersection of information science, computer science, and healthcare. This multi-disciplinary nature of health informatics attracts students from diverse background into MSc HI programmes, with most coming from the health or information sciences fields. Table 2 highlights the consensus-based admission recommendations in the Benchmarks for MSc HI programmes that accommodate for the diverse applicant backgrounds.

Course length

The Benchmarks recommend that full-time MSc HI programme should ideally run for two academic years, with each academic year consisting of two semesters. Part-time MSc HI programmes can run for up to four years as determined by each University's guidelines.

Table 2 – Recommended MSc HI admission criteria

All candidates admitted for the MSc HI should meet the admission requirements below:
1. A Bachelor's degree with honours or a Postgraduate Diploma in a relevant field or equivalent from a recognized institution/university; OR
2. An unclassified Bachelor's degree in a relevant field or equivalent from a recognized institution/university; OR
3. A Bachelor's degree with a pass may be considered if they have two years research experience with at least one publication in the relevant field; OR
4. A Bachelor's degree with a pass may be considered if they have significant work experience relevant to the proposed area of study.

Although this is the recommended MSc HI Admission Criteria, this will be determined by the admitting Institution, as per the approved Students Admission's Policy.

Relevant fields of study by candidates applying to the MSc HI programme include: Health Sciences; Computing or Information Sciences; and any other fields as determined by admitting institution.

Program structure

The Benchmarks recommend that the MSc HI program should be divided into two phases, namely: (1) The basic / foundation phase, and (2) the elective phase.

(1) The basic / foundation phase:

This phase is common for all MSc HI students. In the basic/foundation phase, subject areas can be distinguished as follows:

- **Pre-requisites**
  Students from different academic backgrounds will take preparatory courses as prescribed by the academic department of the various institutions to gain necessary knowledge for the MSc HI.

- **Crossover courses (subject areas)**
  These are courses that provide a foundation for the core courses. Without these courses, it is difficult for students to comprehend the core courses. These courses are taken by students depending on their background. Students from an information sciences background should take courses to familiarize themselves with the healthcare field, while those from a healthcare background should take courses to familiarize themselves with information sciences. Students with neither an information science nor a healthcare background should take both sets of suggested crossover courses to familiarize themselves with both fields.

- **Core courses (subject areas)**
  These courses are common for all MSc HI students. They are the backbone of the discipline and are essential courses offering a thorough foundation of the HI discipline. They are the typical HI courses mandatory for every student.

(2) Elective courses

These are HI courses that students can select that will broaden their knowledge, but are not compulsory. However, a student must meet the minimum credit requirements to graduate in MSc HI. Institutions are responsible for prescribing the courses to be included under electives, depending on their programme objectives. It should be noted that elective courses do not form part of the minimum required courses for MSc HI.

As part of the benchmarks, a consensus was also reached that each MSc HI program should consist of an Attachment and Master's Thesis as described below:

Attachment

This is a period of practical attachment, during which students apply learned core competencies in HI within a real-world setting. Students carry out and present a project of their choice, supervised by qualified academic staff.

Master's Thesis

To graduate, MSc HI students are expected to develop a research proposal, implement and write a thesis in the field of

HI. The students have to successfully defend their thesis as per HEIs guidelines.

Table 3 illustrates courses/subject areas in the various phases of an MSc HI programme that were agreed upon through consensus as part of the benchmarking and harmonisation exercise. Particular attention was paid to covering the breadth of content in the field (guided by IMIA knowledgebase), providing room for programme flexibility for evolution and emerging areas in the field and for responsiveness to regional-specific needs. Course/subject-specific learning outcomes were

Discussion

Universities in the East African region, in collaboration and with leadership from the IUCEA, have collaborated to develop common benchmarks for MSc HI degree programmes in the region. To our knowledge, this is the first demonstration of a credit accumulation and transfer effort in HI within LMICs. This effort facilitates comparability, compatibility and mutual recognition of MSc HI degree programmes and qualifications across the EAC.

Table 3: List of subject areas for the basic phase of the MSc HI programm

CROSSOVER SUBJECT AREAS	CORE SUBJECT AREAS (Students to take all courses)	ELECTIVE SUBJECT EXAMPLES
Students with no Health Sciences Background Foundations of Healthcare and Health Systems Principles of Public Health ***Students with no Information Sciences*** Fundamentals of Information Technology Information System Development	Foundations of Health Informatics Health Information Systems Health Information Standards and Terminology Computerized Decision Support Systems Trends in Health Informatics Legal Issues, Ethics, Equity and Governance in Health Informatics Health Information Systems Project Management, Monitoring & Evaluation Biostatistics Health Data Analytics Research Methods Thesis Attachment	1. Public Health Informatics 2. Security in Health Systems 3. Advanced Programming 4. Imaging Informatics 5. Clinical Informatics

formulated with consideration of the subject's contribution to the overall MSc HI ELOs. For each course, a detailed course outline is provided for guidance in the Appendix of the developed Benchmarks. The course outline includes: example course name, credit units, course description, purpose of course, learning outcomes, content based on competencies, mode of delivery, course assessment, suggested core texts and recommended reference materials.

Subjects/courses within the benchmarks serve as a guide, but titles of the courses may differ among HEIs, as the emphasis should be on content rather than title. Autonomy and the uniqueness of HEIs should be taken into consideration in formulating the core courses. The HEIs will have the choice to add their own courses beyond the core and crossover courses. The core and crossover courses may be designed in the form of modules or course units, as per the HEIs' systems. Courses can be offered using a seminar-based series mechanism, or the programme can have a dedicated seminar series as a course.

Graduation Requirements

In order to graduate, the student should successfully complete the taught courses and related assessments, attachment, research project, and thesis according to the HEI's post-graduate regulations. The best practice is that students should publish at least one article in a peer-reviewed journal as a graduation requirement.

It is envisaged that the benchmarks will support quality assurance of the MSc HI programmes. Through these benchmarks, institutions and external assessment teams have a frame of reference in assessing the quality of a programme. Although each National Commission or Council applies its own criteria in assessing the quality of programmes, the benchmarks will play a significant role in harmonisation of quality assessment and quality assurance at the regional level. The National Commissions and Councils will ideally align their standards for MSc HI with the developed benchmarks. HEIs with existing MSc HI programmes in the region will be expected to review curricula to align to the benchmark recommendations, while tailoring individual courses to their local contexts. The benchmarks will also serve as a reference for use by any new MSc HI curriculum as they develop the program.

It is important to note that the harmonisation and benchmarking process is not synonymous with homogenization. In homogenization, the curricula across the region's universities are the same with limited variability. Rather, harmonisation process refers to the development of minimum academic standards and benchmarks that are agreed upon by the partner institutions. The benchmarks set out the agreed common goals and objectives of the MSc HI degree program and the key learning outcomes and competencies expected to be achieved. It allows the participating institutions the flexibility to decide on programme specializations, curriculum innovativeness and delivery approaches. Universities are encouraged to develop

curricula that are tailored to local contexts while guided by the benchmarks set in the harmonized curriculum.

After formal approval of these benchmarks by the IUCEA, the next steps will involve dissemination to all relevant stakeholders, including HEIs and National Commissions. The benchmarks can be utilized to guide development of shareable modular educational content that can be used by the institutions. Further, the process to support mobility of students and faculty for MSc HI programmes can now be actualized in the region. Given that the benchmarking process is consistent with the African Association of Universities' curriculum harmonisation goal of promoting the comparability of degree programmes and recognition of their equivalencies across the continent, these benchmarks can also be transcended to be adopted by universities/HEIs in the African continent and beyond.[7] Review of the benchmarks will be undertaken every five years as per IUCEA guidelines to ensure that the MSc HI benchmarks remain responsive to regional needs, emerging trends and advances in the field.

Conclusions

The harmonisation of MSc in Health Informatics curricula in the East African Community is a significant first step towards the standardization of quality training in MSc HI and by extension digital health in the region. It is now important to complete the process by encouraging the region's universities/HEIs to review their curricula to align to the minimum benchmarks set forth.

Acknowledgements

References

[1] Were MC, Gong W, Balirwa P, Balugaba B, Yeung A, Pierce L, Ingles D, Kim Y, Lee HJ, Shepherd BE. Comparative Analysis of Competency Coverage within Accredited Master's in Health Informatics Programmes in the East African Region. J Am Med Inform Assoc. 2021 [In Press].

[2] East AFrican Community Common Higher Education Area. Context of harmonization of higher education in the East Afria Community. Available at http://iucea.org/eahea1/harmonization-higher-education-east-african-community/. Last accessed Oct-04-2019.

[3] Trines S. Bologna-type Harmonization in Africa: An Overview of the Common Higher Education Area of the East African Community. World Education News and Reviews. 2018 Available at https://wenr.wes.org/2018/12/common-higher-education-area-chea-of-the-east-african-community. Last access May-03-2021.

[4] Inter-University Council of East Africa. Harmonization of Higher Education in East Africa - Status Update. 2015. Available at http://repository.eac.int/bitstream/handle/11671/2047/Harmonization%20of%20Higher%20Education%20in%20East%20Africa%20Status%20Update.pdf?sequence=1&isAllowed=y#:~:text=The%20process%20of%20harmonization%20of,and%20benchmarks%20for%20academic%20programmes. Last access May-03-2021.

[5] Mantas, J., et al., Recommendations of the International Medical Informatics Association (IMIA) on Education in Biomedical and Health Informatics. First Revision. Methods Inf Med, 2010. **49**(2): p. 105-120.

[6] Were, M.C., et al., Coverage of IMIA-recommended Competencies by Masters in Health Informatics Degree Programmes in East Africa. Int J Med Inform, 2020. **143**: p. 104265.

[7] Initiative, H., African Standards and Guidelines for Quality Assurance in Higher Education (ASG-QA). 2017.

Address for correspondence

Name: Martin C. Were, MD MS FIAHSI FAMIA
Email: martin.c.were@vumc.org
Phone: 615-875-9675
Address: 2525 West End Avenue,
Suite 750
Nashville, TN 37203
U.S.A.