Internal Medicine, East Africa   Medical College, East Africa

2015

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Building Comprehensive and Sustainable Health Informatics Institutions in Developing Countries: Moi University Experience

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Abstract

Current approaches for capacity building in Health Informatics (HI) in developing countries mostly focus on training, and often rely on support from foreign entities. In this paper, we describe a comprehensive and multi-dimensional capacity-building framework by Lansang & Dennis, and its application for HI capacity building as implemented in a higher-education institution in Kenya. This framework incorporates training, learning-by-doing, partnerships, and centers of excellence. At Moi University (Kenya), the training dimensions include an accredited Masters in HI Program, PhD in HI, and HI short courses. Learning-by-doing occurs through work within MOH facilities at the AMPATH care and treatment program serving 3 million people. Moi University has formed strategic HI partnerships with Regenstrief Institute, Inc. (USA), University of Bergen (Norway), and Makerere University (Uganda), among others. The University has also created an Institute of Biomedical Informatics to serve as an HI Center of Excellence in the region. This Institute has divisions in Training, Research, Service and Administration. The HI capacity-building approach by Moi provides a model for adoption by other institutions in resource-limited settings.

Keywords:

Health Informatics; Capacity Building; Developing Countries; Training.

Introduction

Health Informatics (HI) is rapidly being embraced in the developing world[1]. It is now commonplace to see comprehensive deployment and implementation of Electronic Health Record Systems (EHRs). As an example, countries like Rwanda and Kenya have rolled out EHRs at scale within Ministry of Health (MOH) facilities. Other health information systems, ranging from Health Information Management Systems, Laboratory Information Systems, Pharmacy Information Systems, and mobile Health Systems also have increased uptake. Beyond systems, there are multiple initiatives to develop and operationalize national Health Information System (HIS) strategies. At the same time, increasing numbers of evaluations are underway to increase the evidence-base of impact of HIS.

With increasing relevance of HI in developing countries comes the requisite need for comprehensive mechanisms to support these systems. At the very least, countries need appropriate institutional and human capacity in HI. Needed workforce in HI include: (a) Local level: Health IT professionals, eHealth specialized programmers, data managers, implementation managers, support specialists and reporting personnel; (b) Institutional level: Chief medical information officers; and health information management specialists, (c) Administrative: national and regional eHealth coordinators and eHealth monitoring and evaluation specialists, and (d) Other: Health information privacy and security specialists, HI researchers, among others. End users, managers and policy-makers also need appropriate training on relevant aspects of HI.

Over the years, various approaches have been undertaken to improve capacity in HI for developing countries. There are several examples of training programs. The American Medical Informatics Association has had the 10x10 program whose aim is to train 10,000 health care professionals in applied health and medical informatics within 10 years, with some coming from developing countries[2]. The Informatics Training for Global Health Program of the Fogarty International Center is another initiative that aims to improve informatics research training in developing countries[3]. Health Informatics Building Blocks (HIBBS) by the Global Health Informatics Partnership arm of AMIA also provides applied informatics training targeted to developing countries.

Beyond formalized training programs, other approaches to improving capacity have involved direct presence in developing countries of Western institutions, or significant North-South collaboration. Organizations like the International Training and Education Center for Health (ITECH) conducts extensive work and training in HI in multiple developing countries. Regenstrief Institute, Inc., Partners In Health, and numerous universities in the West now have formal relationships with developing country partners and ministries in HI. An exemplar case of institutional partnerships for HI capacity building involves collaboration between University of Washington, Seattle and Universidad Peruana Cayetano Heredia, Peru[4, 5]. The project, called AMUATA, has lasted for over a decade and led to significantly increased capacity through short-term courses, Masters and PhD-level HI training.

Unfortunately, few HI capacity building initiatives can mimic the success of programs like AMUATA. The problem is that most initiatives target narrow dimensions of a broader capacity building framework. It is quite common for individuals to be trained in HI within the Western setting, only to come back home and have no institutional base from which to operate. In fact, these individuals often receive little requisite recognition for their newly acquired skills. Numerous capacity building initiatives also lack buy-in from relevant governmental authorities, with efforts not necessarily aligned with larger national HI capacity-building goals. Some HI training programs also lack solid implementation partnerships to enable applied training in HI within real-world settings.

In this paper, we report on an HI capacity building initiative grounded by a comprehensive and multi-dimensional capacity building framework. We use this case-study approach to high-

light the necessity of a multi-faceted approach to HI capacity building, with the primary goal of realizing self-sustainable locally run HI programs in developing countries.

Materials and Methods

Capacity Building Framework

Lansang & Dennis describe a broad-based capacity building framework that takes into consideration both short- and long-term strategies for capacity building with an eye towards sustainability (**Table 1**)[6]. This framework incorporates various complementary approaches for capacity building, including: (1) graduate or post graduate training; (2) learning by doing; (3) institutional partnerships between developing and developed countries; and (4) centers of excellence. Building HI capacity at the institutional level requires an approach that touches on every aspect of the four dimensions in this framework. It should be noted that training, the most common modality currently used globally for HI capacity building, leads to a lower likelihood for sustainability if implemented in isolation.

Approach

The HI program described in this paper used the comprehensive framework by Lansang & Dennis to build a broad-based and sustainable HI Informatics Program within an institution in a developing country setting. The guiding principles for the HI program are outlined below:

- *Multi-Dimensionality:* The HI program should support various dimensions of HI, including: HI research, HI system development and implementation, and policy guidance.

- *Locally Led:* The program should aim for self-suffiency of the local institution, with little reliance from outside.

- *Strategic Partnerships:* The program should form public-private, North-South, and South-South strategic partnerships as needed to achieve its goals.

- *Government support and Integration:* The program should ideally operate within publicly-funded institutions, and work closely and in alignment with government-supported health and education sectors.

- *Accreditation:* Training programs should be formally recognized within the country, and follow well-accepted core competencies in HI training and education[7-9].

- *Affiliation with an Implementation Setting:* There needs to be an emphasis on applied and practice-based HI. As such, programs should collaborate closely with active care systems, and with larger national HIS ecosystem.

- *Economic sustainability:* Multi-modal approaches for finanacial sustainability, incorporating various business models, should be implemented to avoid excessive reliance on seasonal and time-limited grants or funding approaches.

Setting

The comprehensive HI program, guided by the Lansang & Dennis framework, has been implemented within Moi University in Kenya. Moi University is a public and government supported university located in Eldoret, Kenya[10]. The University was established in 1984 as the second university in Kenya through an Act of Parliament. It currently has 13 schools, 4 directorates and operates 6 campuses, namely: Main Campus, Eldoret West Campus, Odera Akang'o Campus, Mombasa Campus, Nairobi Campus, and Eldoret Town campus. Within the Town Campus is the College of Health Sciences that houses four schools, namely: School of Medicine, School of Public Health, School of Dentistry and School of Nursing. The College of Health Sciences has a student population of about 2,000 with a staff complement of over 500 of which 170 are academic staff. The College of Health Sciences hosts the HI programs.

Results

We describe the activities of the Moi University HI program along the four dimensions of capacity building framework outlined in the Lansang & Dennis framework, namely: (1) Graduate or post graduate training; (2) Learning by doing; (3) Institutional partnerships between developing and developed countries; and (4) Centers of excellence.

Graduate and Post Graduate Training

With support from the Norwegian Agency for Development Cooperation, and as part of the NORHED program, Moi University is leading the Health Informatics Training and Research in East Africa for Improve Health Care (HI-TRAIN) (Norad Project #: QZA-0484) project. This project, currently in its second of five years, has the following specific aims:

- Provide **post-graduate (Masters and PhD) level training in Health Informatics and research**. Targeted groups

Table 1. Matrix of capacity-building strategies, likelihood of sustainability and research focus

Entity targeted	Approach to capacity building			
	Graduate or post-graduate training	Learning by doing	Institutional partnerships between developing and developed countries	Centres of excellence
Individual[a]	+++	+	++	+
Institution	+++	++	+++	+++
Network	++	++	+++	++
National level	+	++	++	+++
Supranational level		++	+++	++
Financial investment[b]	++	+	+++	+++
Research focus →	Research skills ▭▭▭▭▭⟹ Programme, policy, systems			
Likelihood of sustainability[c]	+ ◄─────────────────► +++			

[a] + indicates the entity is targeted sometimes; ++ it is targeted moderately often; +++ it is frequently targeted.
[b] Plus signs in this row indicate the extent of financial investment needed by national health research systems or funding agencies: + for low; ++ for medium; +++ for high.
[c] Plus signs in this row indicate the likelihood of sustainability of various approaches: + for fair; +++ for strong.

include health professionals and individuals with computer science background. Personnel trained in HI-TRAIN become core HI faculty at Moi University.

- Increase **number of women and marginalized populations in faculty-level training in Health Informatics and research**.
- Improve the **quality and quantity of Health Informatics research** conducted primarily by researchers based in the LMIC countries in collaboration Northern partners (*see Institutional Partnerships*).
- Provide **model curricula, educational programs and approaches for faculty-level HI training** that can be emulated by regional higher education institutions.

The two-year Masters in Health Informatics program is approved as a university program, and will train an average of 20 candidates per class. In total, 11 Masters candidates will get full scholarship support under HI-TRAIN program to pursue this degree. In return, these individuals will commit to serving as HI personnel and staff within the University. **Table 2** outlines the approved courses for the Masters program. Faculty for this program will come from various departments within Moi University, and from two other partner institutions for HI-TRAIN program, namely Makerere University, Uganda and University of Bergen (UiB), Norway.

Table 2– Approved Masters in Health Informatics Courses

Course Code	Course Title	Contact Hours	Credit Units
HII 811	Introduction to Healthcare and Health Systems	120	3
HII 812	Principles of Public Health	120	3
HII 813	Introduction to Information Technology	120	3
HII 814	Information System Development	120	3
	Total Introductory Courses (2 courses only)	**240**	**6**
MME 801	Innovative Medical Education	40	1
PHM 801	Principles of Management and Health Systems	120	3
HIC 811	Foundations of Health Informatics	120	3
MMR 801	Research Methods	120	3
	Total Core Courses	**400**	**10**
	Total Courses Semester 1	**640**	**16**
PBS 801	Biostatistics	120	3
HIC 822	Health Information Systems	120	3
HIC 823	Health Information Standards and Terminology	80	2
HIC 824	Clinical Decision Support, Ontologies and Workflow	120	3
HIC 825	Scientific Writing and Grantsmanship	80	2
MMP 999	Research Project Design and Implementation (Thesis)	120	3
	Total Courses Semester 2	**640**	**16**
HIC 831	Enterprise Architecture for Health Information Systems	80	2
HIC 832	Law and Governance in Health Informatics	80	2
HIE 831	Public Health Informatics	120	3
HIE 832	Security in Health Systems	120	3
HIE 833	Advanced Programming	120	3
HIE 834	Health Analytics	120	3
HIE 835	Clinical Informatics	120	3
PEC 801	Epidemiology	120	3
	Total Elective Courses (2 courses only)	**240**	**6**
	Total Courses Semester 3	**400**	**10**
HIP 841	Health Informatics Practicum	240	6
MMR 899	Thesis		9
	Total Courses Semester 4		**15**
	GRAND TOTAL OF ALL COURSES TAKEN		**57**

The HI-TRAIN program is also supporting four faculty members to receive full scholarship to undertake PhD training in HI at UiB in Norway, with research conducted within Moi University setting. As part of the scholarship, the faculty will have a binding agreement to serve within the HI programs at Moi to assure sustainability. Moi University has over the last several years also partnered with Regenstrief Institute, Inc. and Indiana University to also offer formal HI fellowship

training at Regenstrief Institute. Individuals with fellowship training are now back to oversee new HI programs and research at home. With nine faculty members with fellowship or PhD training in HI, Moi University plans have its own locally run PhD program by 2016. The curriculum development and approval processes for this program start in early 2015.

While the Masters, Fellowship and PhD programs all aim to improve institutional capacity in HI, Moi University has also paid attention to improving capacity in direct response to government and implementation partner needs. Moi University is home to the Regional East African Center for Health Informatics (*REACH-Informatics*). This is project funded by Fogarty International Center as part of the Informatics Training for Global Health (ITGH) Program[11]. Since 2010, REACH-Informatics has offered 25 short courses to 469 participants. Courses have included data management, EHRs developer and implementer training, forms & concept dictionary training, and research database training.
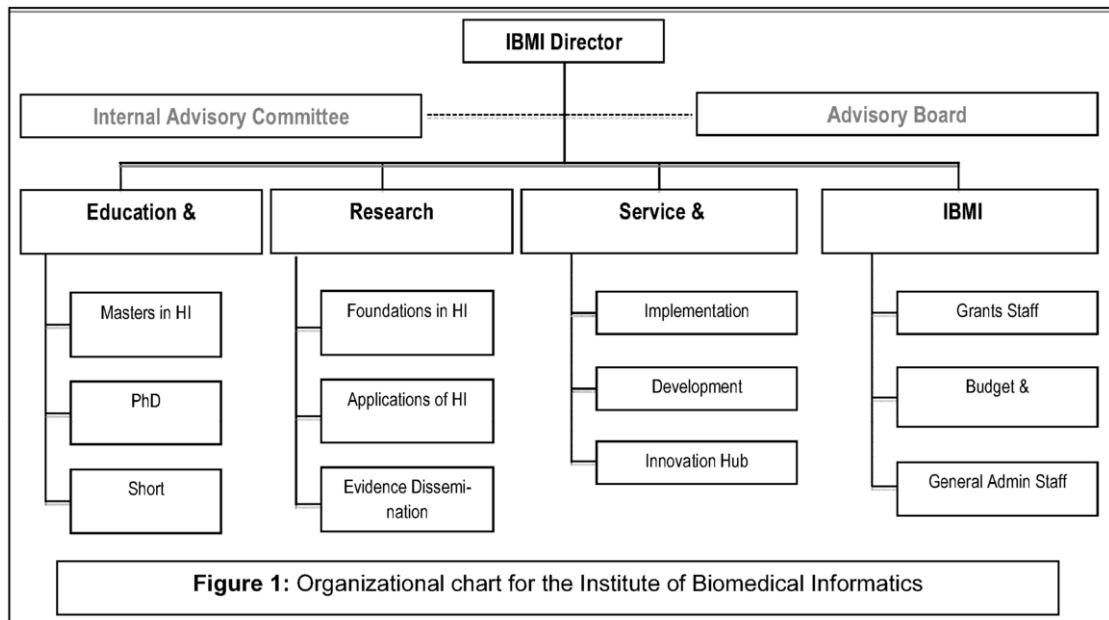
Learning by Doing

Moi University's HI work has been grounded by the need to address real world challenges within the Kenyan setting. The University forms part of a larger care partnership, the Academic Model Providing Access To Healthcare (AMPATH)[12]. AMPATH is a collaborative between Moi University School of Medicine, Moi Teaching and Referral Hospital, and the AMPATH Consortium - a consortium of North American Academic Medical Centers led by Indiana University. Initiated in 2001, AMPATH has used a systems-based approach that closely links clinical care, prevention, research, and training. The program provides comprehensive care and treatment services through 544 MOH facilities and serves a catchment area of three million people.

From its inception, AMPATH recognized the need for comprehensive Health Information Systems to assure optimal care for the people it serves. AMPATH was the first implementation site for the open source electronic record system, OpenMRS, with the implementation called the AMPATH Medical Record System (AMRS)[13]. Success of AMRS helped to convince the Kenyan MOH to roll out OpenMRS in over 300 MOH clinics. Beyond eHealth, AMPATH has used mobile technology for: (a) data collection as part of a home-based counseling and testing for HIV program that has reached over a million individuals; (b) computerized clinical decision support for HIV and chronic disease management; (c) mobile store-and-forward teleconsulttion; and (d) mobile learning and counseling platforms, among others[14-17]. The AMPATH partnership with Moi University offers a real-world laboratory in HI, where trainees can work to complement foundational aspects of HI training. As an innovative arm of the MOH, AMPATH HI innovations largely inform the national conversations in HI.

Institutional Partnerships

A core component to Moi University's HI capacity building initiative is the formation of strong strategic partnerships. These partnerships include:

- *South-South Institutional Partnerships in HI*: Moi University has natural strength in applied Clinical Informatics. The Institution however recognizes that a big part of HI includes foundations of health informatics with a significant computer science component – competencies ranging from algorithms, visualization, analytics, natural language processing, security, to artificial intelligence. To this effect, Moi University has partnered with the School of Computing and Informatics Technology (CIT) of another

Figure 1: Organizational chart for the Institute of Biomedical Informatics

regional university, Makerere University (Uganda) for its HI initiatives. CIT has 22 PhD holders on the academic staff, with fully fledged academic departments in Information Systems, Computer Science, Information Technology and Software Engineering. Makerere is a member of the HI-TRAIN program, and will be sending students for Masters training in HI at Moi University, and making available faculty to teach in the HI degree courses.

- *North-South Institutional Partnerships in HI:* Over the years, Moi University has partnered with Regenstrief Institute, Inc. (RI) and Indiana University to advance global HI. Among the core achievements of this partnership is the development and implementation of OpenMRS. Moi University has also partnered with University of Bergen (UiB), with a particular emphasis on PhD-training of new emerging HI faculty. All Moi University candidates pursuing PhD-training in HI at UiB will have a Bergen University faculty supervisor in addition to a Moi University supervisor. The HI partnership involves the Center for International Health and Department of Informatics at UiB.

- *Public-Private & Public-Public Partnerships:* As a public institution, Moi University has formed strategic partnerships with organizations in both the public and private sector to ensure sustainability. Partnerships include work with ITECH-Kenya to train implementers on KenyaEMR, which is being rolled out broadly with Kenya. The University is also partnering with Jacaranda Health, a social enterprise for health, on mobile and e-learning platforms for health. Partnerships with counties are in the inception phases, with the goal of training county personnel in HI.

Centers of Excellence

It is well recognized that building centers of excellence offers the best chance for sustainability and long standing capacity building efforts[6]. Centers provide academic homes for highly trained faculty in HI and allow for consolidation of numerous approaches to capacity building. To this end, Moi University has established an Institute of Biomedical Informatics (IBMI), to serve as a regional HI Center of Excellence. The IBMI at Moi is made up of: (a) *Education & Training Division* – hosting the Masters program, PhD

program, and short courses; (b) *Research Division* – serving as the research and dissemination arm; (c) *Service & Extension Division* – providing consulting, development and implementation services to MOH and partners in the region; and (d) *Administration Division* – overseeing all administrative aspects of the IBMI (**Figure 1)**. IBMI is an integral part of the University, with core funding coming from the government of Kenya to assure sustainability. Additional sources for Institute financial sustainability come from student tuition, research grants, and service-based fees.

Discussion

Existing approaches to HI capacity building within resource-limited settings remain largely non-comprehensive. In this paper, we present a case study of a publicly-funded higher education institution in a developing country that has taken a multi-dimensional HI capacity building approach guided by a comprehensive framework. This approach incorporates training, learning by doing, partnerships and a center of excellence. The approach can serve as a model for adoption by other institutions in similar resource-limited settings.

There are multiple reasons why the described capacity-building model needs to be the goal for institutions aiming to improve HI capacity in developing countries. To improve HI capacity, countries need highly trained individuals to serve as teachers and trainers. These individuals should ideally be locally-based, and should have a supportive home-institutional environment within which to work. The work should be grounded by the country HI capacity needs and strategies, and by interaction with real-world healthcare settings to inform innovations and evaluations. In a resource-limited setting, chances of self-sufficiency and sustainability can only happen when strategic partnerships are formed to reduce burden to individual institutions. Ideally, core support should come from the country's ministries of education and health, as this will provide an excellent foundation for sustainability, and for alignment with country's HI systems strategy.

The described capacity building approach has its limitations. To implement all dimensions for capacity-building, a significant amount of financial investment is needed. It is fair

to say that this capacity-building model is not necessarily practical for all institutions. It is one best suited for select institutions tasked with a larger role of leading each country's HI capacity building initiatives. It should also be noted that each component of the model can be used to generate financial resources for sustainability. Tuition will be charged for training and degree programs, service fees can be incorporated into the learning-by-doing experience and into centers of excellence activities. Partnerships can also be strategically used to alleviate the financial burden to the institution.

To actualize the proposed comprehensive approach takes time. It would be unrealistic to expect institutions to implement all dimensions at once or within a short period. At the very least, institutions should have a roadmap that would eventually see the actualization of all dimensions over realistic timelines. Alternatively, multiple institutions with complementary strengths can collaborate to create a comprehensive partnership that has every dimension of the model, without necessarily having all components fall under a single institution. As an example, an institution with strengths in HI training can partner with another institution with a HI Center of Excellence.

Funding organizations should pay attention to the models for capacity building they are supporting. The NORHED capacity building initiative by NORAD is a program that is already looking at capacity building initiatives at very comprehensive level. In addition to encouraging all dimensions, the NORHED program also emphasizes gender equity, as females are often underpresented in the Sciences. Other programs that can have impact in this area include ITGH and the Rockefeller's Digital jobs initiative. The goal should be sustainable HI capacity initiatives beyond a grant period.

Conclusion

It is possible to build comprehensive, locally-run HI capacity building initiatives that are sustainable, in line with country capacity building priorities, and which offer high quality and accredited HI training.

Acknowledgments

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