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Assessment of Health Informatics Competencies in Undergraduate Training of Healthcare Professionals in Rwanda

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Abstract

Introduction: Effective and appropriate use of information and communication technologies is an essential competency for all healthcare professionals. To achieve this goal, healthcare professionals should receive the requisite health informatics training during basic and advanced educational programs. This study assessed health informatics competencies in existing curricula of the University of Rwanda for undergraduate training of healthcare professionals in Rwanda. Healthcare professionals often lack knowledge of systematically processing data and information, which affects the decision-making process. As health information technologies increasingly become part of the health care environment, the need to train healthcare professionals with health informatics competencies is growing. **Methods:** A descriptive cross-sectional study with a review of document approach was conducted. Using a census method we assessed the availability of health informatics competencies in existing curricula for undergraduate training of healthcare professionals in Rwanda. **Results:** There is a low presence of health informatics competencies in the studied curricula with only 11 out of 23 competencies (47.8%) having a score of presence greater than 50%. **Conclusion:** To bridge the gap we propose that more health informatics competencies be included in all undergraduate health professions' curricula. Furthermore, the establishment of continuous on-the-job training in health informatics for those who are already practicing is also essential.

Key words: Health informatics, competencies, undergraduate training/education, Healthcare professionals, Rwanda.

Background

The training of competent healthcare professionals is one of the most complex challenges facing education (Sánchez-Mendiola, et al, 2013). One of the main competencies that are indispensable to practice quality medical care in the current healthcare arena is the utilization of informatics (Burnette, De Groote, & Dorsch, 2012).

The concept "health informatics" is the scientific field that deals with the resources, devices and formalized methods for optimizing the storage, retrieval and management of biomedical information for problem solving and decision-making (Burnette et al., 2012). Although the name "health informatics" only came into use around 1973, it is a discipline that is as old as healthcare itself. It was born the day a clinician first wrote down some impressions about a patient's illness, and used these to learn how to treat the next patient (Vedel et al., 2012).

According to the International Medical Informatics Association (IMIA), effective and appropriate use of information and communication technologies is an essential competency for all healthcare professionals; this expectation requires that healthcare professionals be trained, not as medical informaticians but as knowledgeable users of the health informatics technology tools.

The IMIA has defined and promulgated a set of recommendations that emphasizes inclusion of content in all healthcare professional undergraduate curricula that enables healthcare professionals to "efficiently and responsibly use information processing methodology and information and communication technology" (Mantas et al., 2010). The detailed health informatics competencies for undergraduate level in healthcare professionals` education are available in the published Recommendations of the IMIA on Education in Biomedical and Health Informatics, first revision. This International Medical Informatics Association (IMIA) has expertise in the field of education and the IMIA Recommendations on Education in Biomedical and Health Informatics guide curricula development are usually evaluated by national accreditation committees and accredited by IMIA which is an accreditation agency (Mantas et al., 2015).

Healthcare professionals often lack knowledge of the possibilities and limitations of systematically processing data, information and knowledge with the resulting impact on quality decision-making. In order to enhance their practices through better use of information resources, healthcare professionals are often asked to use information technologies of which they have limited appreciation. However, for systematically processing data, information and knowledge in medicine and in healthcare, health care professionals who are well-trained in health informatics are needed (Mantas et al., 2010).This will only be through improved education of healthcare professionals and through an increase in the number of well-trained workers in health informatics, that this lack of knowledge and associated skills can begin to be reversed (Hu, Sun, & Li, 2013).

The idea that medical schools should incorporate topics in information management is not new. In 1984 a panel on the General Professional Education of the Physician (Association of American Medical Colleges) specifically identified health informatics, including computer applications, as an area in which new educational opportunities needed to be developed for physicians and clinicians to be better prepared for the practice of medicine (Espino & Levine, 1998).

There is evidence that information technology has the potential to facilitate patient care delivery by improving decision making, reducing duplicate work, decreasing error, minimizing time spent on documentation and increasing time spent in direct patient care (Chang, Poynton, Gassert, & Staggers, 2011).

The Harvard School of Public Health and the Commonwealth Fund's International Symposium survey of primary care clinicians found that the proportions of primary care clinicians in the following countries who were using

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electronic medical records were as follows: U.S.A (17%), Canada (14%), Australia (25%), New Zealand (52%), and the U.K. (59%) (Anderson, 2007).

In Brisbone, Australia, researchers such as Georgiou, Andrew Lymer, Sharyn Forster, Megan Strachan & Michael Graham (2014) in their research called "Lessons learned from the introduction of an electronic safety net to enhance test result management in an Australian mothers' hospital". There were 27 354 inpatient test results (679 for imaging and 26 675 for laboratory) relating to 6855 patients (involving 7647 episodes of care) across the August 2011 to August 2012 period. The findings showed that all results in the hospital had been acknowledged, with 60% of laboratory tests (n=24 458; 95% CI 59% to 61%) and 44% of imaging tests (n=586; 95% CI 40% to 48%) acknowledged within 24 hours (Georgiou et al., 2014).

In the same vein, Byrne et al., (2010) demonstrated that a Clinical Decision Support System (CDSS) which is an interactive computer software designed to assist health professionals with decision making tasks, such as preventing adverse drug events at the point of care is very helpful to assist in the clinicians' work, still they are reluctant to adopt CDSS because of unfamiliarity of the system. One way to address these problems is through medical education on CDSS within the undergraduate medical curriculum and specifically the health informatics courses(Byrne et al, 2010).

A number of recent studies (Lu, Xiao, Sears & Jacko (2015) suggest that fragmented and inaccessible clinical information adversely affects both the cost and quality of healthcare and compromises patient safety (Lu et al., 2015). Information technology has been proposed as an essential tool in solving these problems and promoting better healthcare. Information technologies (IT) such as electronic health records, e-prescribing, decision support systems, electronic management of chronic disease, and bar coding of drugs and biological products have been shown to reduce healthcare costs and medical errors (Neuner, Fedders, Caravella, Bradford & Schapira, 2014). For example, several studies (Anderson et al., 2007; Bakken et al., 2004; Belar et al., 2004; Blumenthal et al., 2005; Burnette et al., 2012) .have shown that an electronic medical record that facilitates computerized physician order entry can significantly prevent serious medication errors. Electronic prescribing has been shown to reduce prescription errors and improve compliance with managed care formularies. Point-of-care decision support tools can provide providers with alerts for contraindicated medications (Magrabi, Westbrook & Coiera, 2007).

In addition, Espino & Levine (1998) from Brooklyn, State University of New York, carried out a survey called "An Overview of the Medical Informatics Curriculum in Medical Schools". Its results revealed that of the 26 medical schools responding only 1 school reported no informatics subjects in the curriculum. Two schools reported informal teaching of health informatics within existing courses. Nine schools had formal health informatics objectives in the curriculum longer than one year. Eight schools reported the formalization of objectives for this or next year. Six schools reported an elective only curriculum for health informatics. Most medical schools have an interest in a health informatics curriculum. In the most recent profile of medical school curriculum from the AAMC (American Association of Medical Colleges) Curriculum Directory, 1996-1997, 116 schools out of 127 (93%) reported incorporation of health informatics subjects. They concluded by a remark saying that ideally, health informatics should be incorporated into all four years of medical school. The data from this survey reflects this desire (Espino et al, 1998).

Although in New York, they started incorporating health informatics subjects in their undergraduate curricula for medical students 18 years ago, in Africa, specifically in Rwanda there is still a gap in this domain and the research study related to health informatics is scanty especially in Rwanda.

In Africa, the current state of ICT (Information and Communication Technology) and innovation-related policy-making, infrastructure, initiatives, national ICT research priorities, research focus within higher education institutions, across the 18 IST-Africa partner countries is reflected in a report of IST- Africa (Information Society Technologies in Africa) consortium titled "Guide to ICT Initiatives and Research Capacity in IST-Africa Partner Countries Version 1.1". This report emphasizes on ICT incorporated in health sector as a priority of all African countries (IST-Africa Consortium, 2014).

Finally, in Rwanda health information technology is a quickly growing industry with many committed stakeholders, including the Government of Rwanda, several nongovernmental organizations (NGOs), and private sector partners. Particularly in the areas of electronic health records and national reporting system, Rwanda integrated technology into its expanding healthcare system. There are seven significant entities in health information technology in Rwanda to date. These programs already in use are: OpenMRS – an open-source Medical Records System that tracks patient-level data; TracPlus and TRACnet – monthly monitoring of infectious diseases including HIV/AIDS, TB, and Malaria, the Medical Procurement and Production Division (MPPD) – drug and medical supply management system; Telemedicine – information and communication technology (ICT) used to deliver healthcare services, information and education to geographically separate parties; Health Management Information Systems (HMIS) – systems that integrate data collection processing, reporting, and use of the information for programmatic decision-making; Rapid-SMS used to monitor the activity of community health workers (CHWs) whose job is to ensure their respective jurisdictions improve maternal, newborn and child survival, E-Learning – use of ICT in instruction of A2-level nurses for promotion to A1 (Frasier, May & Wanchoo, 2008).

Methods

A descriptive cross-sectional study with a review of document approach was conducted. Using a census method, the study assessed thirty curricula designed for undergraduate training of healthcare professionals at the University of Rwanda, College of Medicine and Health Sciences (CMHS) during the academic year 2013 - 2014. The college consists of 5 schools: the School of Medicine and Pharmacy, the School of Health Sciences, the School of Dentistry, the School of Nursing and Midwifery and the School of Public Health. The CMHS has been chosen because it is the only public healthcare professional training institution in Rwanda. Data collection was carried out using a standardized questionnaire designed to assess health informatics competencies in undergraduate level, the tool was developed from the nursing informatics competencies for four levels of undergraduate nursing by Staggers et al. (2012); it was designed according to Recommendations of the International Medical Informatics Association (IMIA)

on Education for healthcare professionals obtained from Mantas et al (2010). The tool is composed with a set of recommendations which describes ways that curricula should outline specific items related to health informatics, each recommendation was to be rated using a yes-or-no option, reflecting respectively the presence or absence of the concerned health informatics competency in the curriculum. The tool had 3 main sections covering Biomedical and Health Informatics Core Knowledge and Skills; Medicine, Health and Biosciences and Health System Organization; and Informatics/Computer Science, Mathematics and Biometry (Mantas et al., 2010).

Data collection was done in October 2014 after the study was granted an explicit authorization from the ethics committee of the University of Rwanda, College of Medicine and Health sciences. SPSS 21(Statistical Package for the Social Sciences) was used for data coding, processing and analysis. Frequency tables were used to summarize data. Descriptive statistics were used to describe numerical variables. One-way ANOVA was used to compare means differences across schools and undergraduate programmes.

Results

Only 11 out of 23 competencies (47.8%) had a score of presence greater than 50% in the assessed curricula. Use of personal application software for documentation, ability to use personal computers, ability to communicate electronically and basic informatics terminology were the most frequent competencies in curricula and each one accounted for 70% (n=21). Socio-organizational and socio-technical issues and methods of project management and change management were totally absent from all assessed curricula. Other competencies weakly represented included the methods for decision support and their application to patient management (3.3%), the principles of medical decision-making (6.7%), and the need for systematic information processing in healthcare (10%). The remaining competencies had a presence score between 10 and 50%.

To identify whether the availability of health informatics competencies in curricula varies across schools, one-way ANOVA was performed to make multiple comparisons between mean scores. Health informatics competencies in curricula from the School of Medicine and Pharmacy were significantly higher than the others ($p<0.001$) as shown in Table 1. Alpha value was set to 0.05.

The present study found that in the first domain, 'Biomedical and Health Informatics Core Knowledge and Skills', the highest rate of items' presence is 70% (n=21) and the lowest rate is 0% (n=0). The competency that was missing completely in all curricula is related to socio-organizational and socio-technical issues; including workflow/process modeling and reorganization (n refers to the number of curricula that have a competency).

Table 1. Competencies most present in curricula

Competencies	Yes	No	Mean	Standard Deviation
N = 30	n (%)	n (%)		
Use of personal application software for documentation, personal communication including Internet access, for publication and basic statistics	21 (70)	9 (30)	0.70	0.466
Basic informatics terminology like data, information, knowledge, hardware, software, computer, networks, information systems, information systems management	21 (70)	9 (30)	0.70	0.466
Ability to use personal computers, text processing and spread sheet software, easy-to-use database management systems	21 (70)	9 (30)	0.70	0.466
Ability to communicate electronically, including electronic data exchange, with other health care professionals, internet/intranet use	21 (70)	9 (30)	0.70	0.466

N: Number of Curricula

Table 2. Comparison of availability of health informatics competencies according to schools of the College of Medicine and Health Sciences

Schools	Medicine and Pharmacy	Nursing and Midwifery	Dentistry	Community Health Development	Health Sciences
Medicine and Pharmacy	1.000	0.001*	0.000*	0.000*	0.000*
Nursing and Midwifery	0.001*	1.000	1.000	1.000	0.552
Dentistry	0.000*	1.000	1.000	1.000	1.000
Community Health Development	0.000*	1.000	1.000	1.000	1.000
Health Sciences	0.000*	0.552	1.000	1.000	1.000

*The mean difference is significant at the 0.05 level

To assess the availability of health informatics competencies in curricula across different undergraduate programmes, mean scores were analyzed using one-way ANOVA. Post Hoc test (Bonferonni) was used to systematically compare differences between mean scores of two programs. The significance level was set to 0.05. The results are summarized in Table 2, which shows that the Bridging program was less likely to contain assessed health informatics competencies ($p<0.05$) as shown in Table 2. Alpha value was set to 0.05.

Table 3. Significance of differences between means for different programs

Domain-areas		Advanced Diploma	Bachelor`s Degree	Bachelor`s Degree with honours	Bridging Program
Biomedical and Health Informatics core knowledge and skills	Advanced Diploma	1.000	1.000	1.000	0.000*
	Bachelor`s Degree	1.000	1.000	1.000	0.000*
	Bachelor`s Degree with honours	1.000	1.000	1.000	0.002*
	Bridging Program	0.000*	0.000*	0.002*	1.000
Medicine, Health and Biosciences and Health Systems organizations	Advanced Diploma	1.000	0.360	1.000	0.126
	Bachelor`s Degree	0.360	1.000	0.155	0.001*
	Bachelor`s Degree with honours	1.000	0.155	1.000	0.413
	Bridging Program	0.126	0.001*	0.413	1.000
Informatics/Computer science, mathematics and Biometry	Advanced Diploma	1.000	1.000	1.000	0.001*
	Bachelor`s Degree	1.000	1.000	1.000	0.001*
	Bachelor`s Degree with honours	1.000	1.000	1.000	0.021*
	Bridging Program	0.001*	0.001*	0.021*	1.000

*. The mean difference is significant at the 0.05 level.

Discussion

The aim of the study was to assess health informatics competencies in existing curricula from the University of Rwanda for undergraduate training of healthcare professionals in Rwanda.The total number of undergraduate curricula which were analyzed in this study was 30. The assessed health informatics competencies in each curriculum were 23 competencies under 3 domain areas of health informatics competencies as stipulated in the existing international recommendations in health informatics/ medical informatics education by the IMIA (Herbert et al., 2010).

With regard to the second domain, 'Medicine, Health and Biosciences and Health System Organization', the study reveals that the higher rate of items' presence is 60% (n=18) and the lower rate is 7% (n=2). In the third domain, 'Informatics/Computer Science, Mathematics and Biometry', the higher rate of items' presence is 70% (n=21) and the lower rate is 0% (n=0); for this domain area, there were also a competency missing completely in all curricula which is item 3.5. Methods of project management and change management.

When considering each specific item/competency availability in curricula, we computed a mean and a standard deviation of every competency after recoding data from binary scale to numerical scale. A yes-option was equivalent to one (1), while a no-option was equivalent to zero on the new scale. The corresponding results reflect statistically the presence or the absence of the competency in curricula (Mean value far from 0 , the competency is present ; Mean value closer to 0, the competency is missing), there were 4 items/Competencies most present in curricula (Mean score= 0.70). Table 3 lists the mean value and standard deviation for Competencies most present in curricula.

As far as health informatics education is concerned, the results of the present study are similar to those we find in the literature related to the field of health/medical informatics, where it is reported that even though health informatics education is an essential component of the undergraduate healthcare professional curriculum, it remains controversial with no clear consensus on which knowledge and skills should be integrated in a baccalaureate healthcare professional program. The literature argued that basic medical science education must include health/medical informatics (De Gagne, Bisanar, Makowski & Neumann, 2012). To identify whether the availability of health informatics competencies in curricula varies according to different schools or not, we examined the answers that were provided by our tool which reviewed curricula and we computed a mean score. It was this mean score that was used to make a comparison within and between groups. One Way Analysis of the Variance (ANOVA) model was used and the alpha value was 0.05. From our research findings, it can be seen that Bonferonni post-hoc test revealed that the school of medicine and pharmacy was statistically significantly higher. However, there were no differences between the other remaining 4 schools ($P>0.05$).

Similarly, another survey that was conducted involving 17 Canadian medical schools revealed that despite many efforts undertaken, the uptake of Medical/health Informatics into undergraduate medical education has been poor and as medical schools incorporate medical informatics into their curriculum the problems of implementation arise. Because there were no standards regarding a medical informatics curriculum, medical schools were implementing the subjects in various ways (Espino & Levine, 1998).

Further, it was identified by the Institute of Medicine (IOM) Texas, USA report that a transformation in healthcare was needed. This report made a call for the use of health information technology (IT) to enhance the quality, safety, and efficiency of healthcare. The IOM's transformation suggested improving communication between providers and patients, automating clinical information, reducing errors, and promoting evidence-based practice (Ehnfors & Grobe, 2004).

In the same vein, D.price (2015) in his research entitled, "What are the implications of implementation science for medical education? argued that utilizing information science in medical education can help us better achieve changes in competence, performance, and patient outcomes (Price et al., 2015).

There are many opportunities worldwide for obtaining education in the field of health informatics. In some countries, there are extensive educational components in biomedical and health informatics (BMHI) at different levels of education and for the different healthcare professions (Mantas et al., 2010). However, it is recommended that these be introduced in stages and integrated into existing training programmes rather than taught as a separate course. At the same time, medical schools should support the integration of e-learning in the educational process in view of the numerous potential benefits (Mantas et al., 2010).

Limitation of the study

The limitation of the study relates to the fact that the researcher encountered a problem of a small sample size, 30 curricula are the only curricula currently used in teaching and learning in College of Medicine and Health Sciences for undergraduate healthcare professionals.

Conclusion

There is a low presence of health informatics competencies in the studied curricula from the College of Medicine and Health Sciences at the University of Rwanda. To ensure that healthcare professionals have the knowledge, skills, and attitudes to effectively and efficiently interact with today's health information technologies, more health informatics competencies need to be included and assessed in all undergraduate curricula leading to a healthcare professionals' qualification in Rwanda.

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Conflict of interest

All authors report no conflict of interest.

Authors' contributions

NA conceived the study, performed the statistical analysis, drafted and approved the manuscript. MN supervised the study, NA, MN, MV and NJL reviewed and provided substantial edits. All authors approved the final version of the manuscript.

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