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Towards the TIGER International Framework for Recommendations of Core Competencies in Health Informatics 2.0: Extending the Scope and the Roles

Ursula Hübner[a], Johannes Thye[a], Toria Shaw[b], Beth Elias[c], Nicole Egbert[a], Kaija Saranto[d], Birgit Babitsch[e], Paula Procter[f], Marion J. Ball[g]

[a] *Health Informatics Research Group, University of Applied Sciences Osnabrück, Osnabrück, Germany*
[b] *Healthcare Information and Management Systems Society (HIMSS), TIGER Initiative, Chicago, IL, USA*
[c] *University of Scranton, Scranton, Pennsylvania, USA*
[d] *Dept. of Health and Social Management, University of Eastern Finland, Kuopio, Finland*
[e] *Institute of Health and Education, New Public Health, Osnabrück University, Osnabrück, Germany*
[f] *Sheffield Hallam University, Sheffield, South Yorkshire, United Kingdom*
[g] *IBM Research, Baltimore, Maryland, USA*

Abstract

This paper describes the methodology and developments towards the TIGER International Recommendation Framework of Core Competencies in Health Informatics 2.0. This Framework is meant to augment the scope from nursing towards a series of six other professional roles, i.e. direct patient care, health information management, executives, chief information officers, engineers and health IT specialists and researchers and educators. Health informatics core competency areas were compiled from various sources that had integrated the literature and were grouped into consistent clusters. The relevance of these core competency areas was rated in a survey by 718 professional experts from 51 countries. Furthermore, 22 local case studies illustrated the competencies and gave insight into examples of local educational practice. The Framework contributes to the overall discourse on how to shape health informatics education to improve quality and safety of care by enabling useful and successful health information systems.

Keywords:

medical informatics, competency-based education, health professions

Introduction

The notion that health information systems success does not only depend on good technology but also on capable users has been accepted for many years in the context of participatory systems design [1] and the task-technology-individual models [2]. However, it has received momentum only in the last decade with increasing health IT adoption rates world wide [3]. Thus, realistic scenarios for using IT on a large scale emerged and necessitate a competent workforce. While clinical end users and their practical skills are widely discussed, health informatics competencies of IT decision makers, often at the board level, have only recently received attention [4]. Hence, health informatics covers a wide field of competencies for all different types of professionals in the healthcare arena, at different levels, and is connected with the need for life long learning. Against this backdrop, national and international professional and scientific associations are undertaking great efforts to develop [5-7] and update educational recommendations [8]. TIGER (Technology Informatics Guiding Education Reform) started issuing recommendations for basic IT competencies for nurses [9] and moved on to develop a comprehensive framework of recommendations of health informatics. This framework accounts for the increasing complexity and sophistication of competencies needed for different roles in nursing [10]. However, it is restricted to nursing and does not include other professions. The primary goal of this study, therefore, was to extend the scope of the framework of recommendations of health informatics core competencies beyond nursing and to include further professional roles that contribute to the success of health information systems. Hereby, the relevance of pertinent core competency areas for the different roles should be designated and illustrated. The secondary goal was to reconcile the global perspective on educational recommendations with the local perspective reflecting an in-depth view and practical experience. As the approach for this framework should pursue a very similar rationale and methodology we decided to call it "International Recommendation Framework of Core Competencies in Health Informatics 2.0". This paper describes major milestones towards this framework.

Methods

The development of the International Recommendation Framework of Core Competencies in Health Informatics 2.0 was performed under the umbrella of the EU Horizon 2020 project EU*US_eHealth_Work addressing workforce development and of TIGER (Technology Informatics Guiding Education Reform). TIGER is a grassroots initiative formalised in 2006 within the nursing community before transitioning to the Healthcare Information and Management Systems Society (HIMSS) in 2014 with members in 26 countries worldwide. TIGER now embraces an interprofessional focus that covers a great field of different health care professionals. In order to address the **first goal**, six professional roles were identified that belong to the communities of either IT users, IT decision makers, IT technologists or IT researchers & educators. Knowing that these communities overlap we more specifically defined the roles as (1) direct patient care (mainly physicians, nurses, therapists) and (2) health information managers belonging to the users, (3) executives (clinical and administrative) representing the decision makers, (4) chief information officers (technical and clinical) in their dual position as decision makers and technologists, (5) engineers and health IT specialists as members of technologists, and

finally (6) science & education forming the group of researchers and educators. The core competencies that should be assigned to the professional roles were compiled from the Recommendation Framework for nurses, which integrated existing recommendations of well-known scientific and professional associations, e.g. IMIA [5] and AMIA [7], and from the HITCOMP tool [11]. In comparison to the Recommendation Framework for nurses the following new competency areas were included: public health informatics, consumer health informatics and learning techniques. In addition, other competency areas were now marked as separate areas, i.e. communication, healthcare processes & IT integration, legal issues, interoperability & integration, and life cycle mangement. Previously these areas had been subsumed under other areas in the Framework for nurses. Information and communication technology was split into two areas: applications and architectures. Finally, three areas were rephrased to be more general. These changes were made to adapt the list to the broader professional scope. This adaptation was performed by four experts that mapped both competency lists, i.e. the nursing one [10] and the one from the HITCOMP tool [11], and finally agreed on utilising 33 core competency areas for the Framework 2.0 (see Table 1).

Table 1 – Core Competency Areas in Alphabetical Order

Applied computer science	Interoperability and integration
Assistive technology	IT risk management
Change/stakeholder management	Leadership
Clinical decision support by IT	Learning techniques
Communication	Legal issues in health IT
Consumer health informatics	Medical technology
Data analytics	Principles of health informatics
Data protection and security	Principles of management
Documentation	Process management
e/mHealth, telematics, telehealth	Project management
Ethics in health IT	Public health informatics
Financial management	Quality and safety management
Care processes and IT integration	Resource planning & management
ICT / systems (applications)	Strategic management
ICT / systems (architectures)	System lifecycle management
Information management research	Teaching, training, education
Information and knowledge management in patient care	

In order to obtain the relevance ratings for the core competence areas, a questionnaire was developed that amongst others included a section on competencies. Initially, twelve different roles were distingushed that were then grouped to match the six different roles of healthcare professionals mentioned above. Similar to the Framework for nurses, relevance ratings could range from 0 to 100. The survey participants rated the relevance of competencies for those professional roles they were competent to speak to. Explanations of what the core competency areas embraced were included in the questionnaire. After pretesting, the survey was finally made available online from the middle of February to the end of June 2017. As the relevance rating should yield a global picture, the survey link was deployed via 60 global listservs comprised of individuals and international, European and North American organisations that represent healthcare professionals. The organizations were asked to share it amongst their members. Due to this deployment policy the people who were invited could not be exactly specified by number. As the same data had been used to analyse options for interprofessional education, the survey methodology had been described also in [12] with a slightly different focus and with clusters of professions that partly varied from this approach.

The **second goal** of this study was to exemplify and illustrate the global findings with a local perspective. To this end, case studies from different countries were identified to illustrate the core competence areas by practical and detailed descriptions of individual competencies. As it was necessary to obtain comparable descriptions with a similar focus and structure, a template for reporting the case was developed that incorporated the principles of case studies [13]. The template was divided into sub-sections for: author, organisation, background, status of current developments, activities and measures, changes, results and outlook and lessons learnt. There was a checklist of eHealth topics alligned with the list of core competency areas of the questionnaire, e.g. process and workflow management, consumers and populations, research, data science, ethics, legal and data protection. The template also included a checklist to aid the case study authors referring to crucial areas, e.g. teaching the teachers, integrating health informatics into traditional curricula and motivating clinicans and managers.

In order to obtain authentic and first hand information, it was decided that the case descriptions should be provided by the persons who were actually involved in this case, e.g. as developer of the educational programme and/or as teacher in this programme. The recruitment of case study authors was initialised by an open call that was launched in July 2017 and closed in January 2018. The call was made public via HIMSS community listservs, the European Health Telematics Association (EHTEL) and other EU*US_eHealth_Work project members. A total of 214 individuals from all around the world were personally invited aiming at experts affiliated with major leading institutions in their field. In addition, general invitations via the HIMSS listservs, national and international conferences, e.g. MEDINFO 2017, were made public. Upon receipt of the case study manuscript the descriptions were edited by authors of this paper (TS, BE, UH) in cooperation with the case study authors.

Results

Goal 1: Relevance of core competency areas. A total of 718 experts from 51 countries provided answers to the questions on health informatics competencies. The 51 countries were composed of 28 European countries, 10 Asian countries, 8 countries from Middle and South America, 2 African countries, the USA, Canada and Australia (see [4] for further demographics). These answers corresponded with 1,571 relevance ratings for professional roles. Out of these answers, 27 were excluded either because they addressed health professions not meant to be focused on in this Recommendation Framework or received not enough answers, e.g. pharmacists. Table 2 gives an overview of the top 10 core competency areas and their mean relevance for the six professional roles. Relevance means were high among the top 10 across all roles ranging from 96.4 to 81.1. Each role was characterised by a unique pattern of top 10 competency areas out of which the first three were separately marked (see Table 2). Communication appeared in all six roles among the top 3. Other core competency areas in the top 3 were more role specific. Direct patient care for example was further featured by documentation and information & knowledge management while the executive role was characterised by leadership and quality & safety management. Beyond the rather distinct role profiles it is noteworthy that some core competency areas were shared by a majority of the roles: Among the top 10, leadership and ethics in health IT appeared in all six roles, quality & safety management, documentation and care processes & IT integration in four out of the six roles. All other competency areas were more specific and described only three or fewer roles. As the absolute relevance ratings ranged in a rather small interval from about 10 points per role (e.g. for direct patient care from 92.4. to 81.1) among the top 10, there were sometimes only minimal

differences between one rank and the next one. For example in the role of engineers and health IT specialists, documentation on rank 9 received a mean relevance of 82.1 and process management on rank 10 had a mean value of 82.0.

Table 2- Top 10 Core Competency Areas in the Six Roles and Related Mean Relevance (REL - 0…100)

	Direct patient care (DPC) (nurses/physicians/therapists)	
	Core competencies	***REL ± SD***
1	*Communication* [n=335]	92.4 ± 14.5
2	*Documentation* [n=337]	91.7 ± 17.2
3	*Information & knowledge management in patient care* [n=335]	90.0 ± 17.5
4	Quality & safety management [n=333]	87.5 ± 18.9
5	Leadership [n=336]	86.2 ± 19.0
6	Learning techniques [n=334]	85.6 ± 18.8
7	Teaching, training & education in healthcare [n=333]	84.4 ± 21.0
8	Ethics in health IT [n=334]	83.8 ± 23.0
9	Information & communication technology (applications) [n=332]	81.6 ± 20.5
10	Care processes & IT integration [n=333]	81.1 ± 21.3
	Health information management (HIM)	
	Core competency area	***REL ± SD***
1	*Communication* [n=184]	90.1 ± 19.0
2	*Documentation* [n=184]	87.7 ± 18.0
3	*Data analytics* [n=183]	87.7 ± 17.9
4	Leadership [n=184]	87.0 ± 19.0
5	Data protection & security [n=184]	86.9 ± 19.3
6	Information & knowledge management in patient care [n=182]	86.2 ± 19.4
7	Ethics in health IT [n=184]	85.6 ± 20.2
8	Principles of health informatics [n=182]	85.1 ± 18.4
9	Care processes & IT integration [n=183]	84.8 ± 19.1
10	Learning techniques [n=184]	84.2 ± 20.2
	Executives (EXC) (clinical and administrative)	
	Core competency area	***REL ± SD***
1	*Leadership* [n=55]	96.4 ± 7.8
2	*Communication* [n=55]	95.8 ± 8.3
3	*Quality & safety management* [n=55]	90.4 ± 16.1
4	Information & knowledge management in patient care [n=55]	89.2 ± 16.9
5	Strategic management [n=55]	89.1 ± 21.0
6	Principles of management [n=55]	88.6 ± 20.ß
7	Legal issues in health IT [n=55]	87.6 ± 16.3
8	Process management [n=55]	87.5 ± 16.4
9	Resource planning & management [n=55]	87.3 ± 21.7
10	Ethics in health IT [n=55]	87.0 ± 18.3
	Chief information officers (CIO) (clinical and technical)	
	Core competency area	***REL ± SD***
1	*Leadership* [n=62]	93.8 ± 9.6
2	*Communication* [n=62]	93.2 ± 10.7
3	*Care processes & IT integration* [n=62]	91.8 ± 13.7
4	Principles of management [n=61]	90.8 ± 12.2
5	Quality & safety management [n=61]	90.5 ± 12.7
6	Strategic management [n=61]	90.0 ± 13.4
7	Process management [n=62]	89.6 ± 13.6
8	Change & stakeholder management [n=61]	89.6 ± 12.6
9	Ethics in health IT [n=61]	88.7 ± 18.0
10	Resource planning & management [n=61]	88.4 ± 18.7
	Engineering or health IT specialist (ENG)	
	Core competency area	***REL ± SD***
1	*Communication* [n=172]	91.3 ± 14.3
2	*Care processes & IT integration* [n=171]	87.5 ± 18.9
3	*Information & communication technology (applications)* [n=171]	87.2 ± 18.0
4	Leadership [n=172]	86.1 ± 17.8
5	Project management [n=172]	85.4 ± 19.7
6	Data protection & security [n=171]	84.3 ± 22.6
7	Ethics in health IT [n=170]	83.4 ± 22.2
8	Interoperability & integration [n=172]	83.0 ± 21.7
9	Documentation [n=172]	82.1 ± 22.6
10	Process management [n=172]	82.0 ± 21.7
	Science and education (S&E)	
	Core competency area	***REL ± SD***
1	*Communication* [n=218]	91.6 ± 16.1
2	*Teaching, training & education in health care* [n=220]	89.2 ± 17.9
3	*Leadership* [n=218]	88.2 ± 17.3
4	Learning techniques [n=218]	88.1 ± 18.8
5	Ethics in health IT [n=219]	86.5 ± 21.3
6	Documentation [n=222]	86.3 ± 21.2
7	Information & knowledge management in patient care [n=221]	86.3 ± 20.2
8	Principles of health informatics [n=218]	83.3 ± 23.2
9	Quality & safety management [n=220]	83.1 ± 22.9
10	Data analytics [n=218]	81.9 ± 23.6

In order to further group the core competency areas, clusters used in the Recommendation Framework for nurses were tested for consistency and adapted if needed. Table 3 shows the Cronbach's alpha values for the six roles and seven clusters, i.e. data/information/knowledge (DIK), information exchange/ information sharing (IEIS), ethical/legal issues (EL), systems/ system principles (SYS), management (MAN), technology (TECH) and teaching/learning (LRN). Only data analytics (STAT) was not assigned to any of the clusters and stands on its own. Thus, a consistency check was not necessary. The great majority of alphas received acceptable values, well above or very close to 0.7, hinting at consistent clusters. This held not true only for three role cluster combinations. The clusters were constructed with some overlap [10], e.g. public health informatics was assigned to DIK and IEIS.

Table 3 - Cronbach's Alpha Values for the Roles and Clusters (No. Core Competency Areas)

Clusters	**Roles**					
	DPC	ENG	HIM	EXC	CIO	S&E
DIK (8)	0.86	0.88	0.90	0.86	0.82	0.92
n	322	161	174	54	61	211
IEIS (8)	0.88	0.88	0.91	0.91	0.88	0.92
n	321	160	171	54	59	207
EL (3)	0.82	0.87	0.90	0.79	0.87	0.89
n	330	169	182	55	61	217
SYS (4)	0.85	0.85	0.88	0.90	0.85	0.91
n	324	167	176	54	61	212
MAN (10)	0.92	0.92	0.95	0.92	0.92	0.95
n	326	166	175	54	61	212
TECH (2)	0.49	0.71	0.65	0.68	0.73	0.76
n	325	163	175	55	59	211
LRN (2)	0.68	0.57	0.83	0.63	0.81	0.80
n	332	166	181	54	62	218

Goal 2: Illustration of the core competency areas. So far a total of 22 case studies from 19 countries were obtained which covered the views from universities (15), from hospitals, (3) from the perspective of countries (3) and one from an educational IT system (decision support). The university courses described offered education at the level of Bachelor, Master and continuing education programmes. The educational activities of hospitals targeted workforce development while the country perspectives reflected needs and national programmes to establish and deepen health informatics education. Due to the nature of health informatics, all case studies blended technical and health topics, however, with various foci and targeting different roles. The majority (17) addressed students and professionals in Direct Patient Care (DPC) either as the only role or in combination with a different role. Six case studies covered the Executive role (EXC) and four the Chief Information Officer role (CIO) either alone or in

combination. Two cases exemplified a curriculum focusing on engineers/health IT specialists together with other roles. Finally, one case study described the need for health informatics in general irrespectively of a dedicated role. Currently all 22 case studies are available from [14]. There were 7 dedicated interprofessional cases and others also stressed the importance of mutual exchange between the students and professionals. In the following some examples are given to show how the case studies illustrate the core competency areas and break them down into individual competencies.

Case Study 1: Indiana University School of Informatics and Computing, Indianapolis, Indiana, United States (Josette Jones)

Case study 1 describes a module-based flexible workforce training program with 21 one-credit modules for anyone who needs training in health informatics, in particular students from health professional programs (e.g. physicians, nurses, public health), professional health care staff members (e.g. from patient centred medical homes, community health centres). It thus addresses all professional roles of this Framework. The following competencies belong to the areas systems/system principles (SYS) and data/information/ knowledge (DIK):

EHR systems development & implementation: Identify the range of clinical decision support (CDS) tools within the EHR; determine which tool is appropriate for specific situations; analyze how to develop and implement CDS tools to adhere to meaningful use criteria. Describe the processes of developing or selecting an EHR system, preparing and supporting clinicians for system implementation and evaluating system effectiveness. Clinical data and clinical process modeling; Technical security applications and issues; Systems testing and evaluation.

Case Study 2: Laurea University of Applied Sciences and Arcada University of Applied Sciences, Finland; Tartu Health Care College, Estonia; Red Cross Medical College of Rīga Stradiņš University, Latvia (Outi Ahonen, Jonas Tana, Gun-Britt Lejonqvist, Marge Mahla, Sanita Marnauza, Elina Rajalahti)

The curriculum, whose development was funded by the EU Central Baltic Program 2014-2020, is multi-professional and combines health and welfare with IT and service design. In the three study units (15 credit points), future professionals from different fields of study (IT, social care, economics and health care) are developing their own unique competencies according to the pedagogical principle "learning by developing". The following example of competencies is taken from unit 2 that focuses on the cluster ethical/legal issues (EL):

Understand ethical theories, safety procedures, principles and laws affecting digital health and welfare as well as customer privacy. Have the skills to practice ethical and high quality customer service taking responsibility for the safety and integrity of the client.

Case Study 3: Assuta Medical Centers, Israel (Rachelle Kaye)

The main drivers at Assuta Medical Centers, the largest private hospital system in Israel, for process changes and associated skills and capabilities, including eHealth competencies, is the striving to steadily improve the quality of care. Continuing education, hereby, is devided into developing basic, intermediate and advanced skills and competencies and is meant to reach all professionals within Assuta. Assuta, which publishes a professional journal, therefore emphasises analytical competencies (STAT) as the following example taken from advanced skills and capabilities shows:

Research and Data Analytics: Perform digitally supported research and database research, or data analytics, design database for research purposes, on-going management and patient care improvement.

The three case studies were chosen against the background to illustrate and reflect ongoing activities to increase the health informatics competencies of all healthcare professionals in a process of life long learning. The case studies were also selected on the basis to represent countries with a high adoption rate of health IT.

Discussion

The current state of the "International Recommendation Framework of Core Competencies in Health Informatics 2.0" developed by TIGER within the EU*US_eHealth_Work project utilizes a robust methodology of surveying healthcare stakeholders across countries worldwide about the relevance of core competency areas and is grounded on a rigorous method to obtain comparable local exemplar case study descriptions. The methodolody was rooted in the approach pursued by the Recommendation Framework for nurses [10] and was further developed regarding the breadth of core competency areas included, the outreach to obtain views from all around the world including Africa and the highly systematised manner of case study descriptions. The recommendation framework is meant to serve as a compass for teachers, students and healthcare organisations to identify patterns of core competency areas and practical advice how the competencies are embedded in a curriculum and realised in a local setting.

The relevance findings point to the paramount importance of communication as the connecting link between different stakeholders with various interests (silo mentality), different settings (primary, secondary vs. tertiary care) and other types of fragmentation. Communication is coupled with leadership, another competency area that runs like a golden thread through the relevance ratings across the roles. It is noteworthy that leadership is not only esteemed relevant at the board level but at all levels and goes along with different professional scopes. This finding matches the increasing awareness of intrapreneurship [15] as a key factor for health IT success. It describes the capability of individuals to assume responsibility, initiate projects and become an innovation champion. Communication and leadership as drivers for health IT correspond with the knowledge about the ethical constraints and skills how to balance diverging interests. Ethics in health IT was thus also found relevant for all roles and is illustrated by the Finish, Estonian and Latvian curriculum that dedicated one out of 3 modules to this topic.

At a more aggregated level, these results concur with four out of the ten foundational domains identified by the latest AMIA white paper on core competencies at master's degree level [8] that revolve around social and behavioural science/aspects and leadership. The IMIA recommendations from 2010 [5] mentioned socio-organizational and socio-technical issues and ethical and security issues as two areas from a list of 19 biomedical/health informatics core knowledge and skill areas for IT users and biomedical and health informatics specialists.

Among the information systems core competency areas care processes & IT integration was found to be essential not only for technically oriented roles but also for direct patient care. This demonstrates that the stakeholders must possess knowledge that crosses the health – technology boarder. Data analytics seems to be an emerging field in the age of Big Data,

however, not yet found central for all roles. In countries with a complete adoption of electronic health records, data analytics is just the next step in digitisation. The comprehensive utilisation of the data is very well illustrated by case study 3 from Israel.

A question that often arises in the context of education is whether interprofessional courses are meaningful. Judging by the core competency areas shared across the professional roles, interprofessional approaches seem feasible and are current practice as a series of the case studies demonstrated. A specific analysis on this topic based on the same data [12] had shown that the relevance ratings between nurses and physicians did not differ significantly, thus supporting this option. Also many of the case studies addressing direct patient care did not specifically distinguish between the professions working directly with patients. This discussion is further fueled by the demand of joining health and social care [16] in particular for the elderly and other vulnerable groups.

There are some limitations that need to be deliberated. Although the survey findings embraced the voice of experts from 51 countries, the very large majority came from North America and Europe. Thus, a bias towards industrialised countries cannot be excluded. This bias can be partly mitigated by including case studies from as many countries as possible. Indeed, it was possible to garner case descriptions from China, India, Saudi Arabia and Nigeria amonst others. However, more insight into local educational practice is required to complete the Framework. These case studies should not only represent more countries but also cover all professional roles in an even manner. Similar to the Framework for nurses an expert workshop with discussions on the roles, the core competency areas and the relevance ratings is desirable. These activities constitute the next steps towards finalising the Framework.

Conclusions

The TIGER International Recommendation Framework of Core Competencies in Health Informatics 2.0 is based on a proven methodology and well on its way with global findings and local exemplar case studies. It contributes to the overall discourse how to shape health informatics education. Furthermore, these findings should help stimulating the discussion within IMIA's work on educational recommendations.

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Address for Correspondence

Ursula Hübner, PhD, University AS Osnabrück, Caprivistraße 30A, 49076 Osnabrück, Germany, E-mail: u.huebner@hs-osnabrueck.de (prefered), phone +49 541 969-2012.