Digital Professionalism in Health and Care: Developing the Workforce, Building the Future
P. Scott et al. (Eds.)

doi:10.3233/SHTI220909

Medical Informaticians' Skills and Competencies to Achieve Roles and Opportunities: A Qualitative Study

Soheila SAEEDI[a], Sharareh R Niakan KALHORI[a,b], Sorayya REZAYI[1, a], Mozhgan TANHAPOUR[a], Marsa GHOLAMZADEH[a]

[a] *Department of Health Information Management and Medical Informatics, School of Allied Medical Sciences, Tehran University of Medical Sciences, Tehran, Iran*
[b] *Peter L. Reichertz Institute for Medical Informatics, TU Braunschweig and Hannover Medical School, 38106 Braunschweig, Germany*
Soheila Saeedi https://orcid.org/0000-0003-1315-794X
Sharareh R. Niakan Kalhori https://orcid.org/0000-0002-7577-1200
Sorayya Rezayi https://orcid.org/0000-0001-7423-8853
Mozhgan Tanhapour https://orcid.org/0000-0003-4691-4740
Marsa Gholamzadeh https://orcid.org/0000-0001-6781-9342

Abstract. For Medical Informatics graduates, there is no compatibility between the training knowledge and skills at universities and the job requirements. This study aimed to determine the skills and competencies requirements for medical informatics graduates and possible job positions in an emerging discipline. This qualitative study was conducted using a questionnaire developed by the researchers. Nine independent medical informatics professionals assessed the initial draft of this tool to determine its face and content validity, and reliability. The questionnaire was distributed among 80 medical informaticians with a doctorate or a master's degree. In this study, items with an average of 4 and higher were confirmed; out of the 78 items, 66 were approved. The highest number of unapproved items was related to managerial knowledge and skills. Research knowledge, training skills, individual skills, technical capacities, specific skills in the health industry, and managerial skills are the main areas that graduates must learn. This survey can help develop a curriculum and job descriptions for medical informatics.

Keywords. Medical informatics, competency, curriculum, skill, employment

1. Introduction

Medical informatics (MI) is an interdisciplinary field of information and computer sciences with health care data management. One of the key challenges to executing communication technology and health information attends the need for a skilled workforce to comprehend communication and information technologies and health care,

[1] Corresponding author: Sorayya Rezayi Contact detail: +9821-88982782. Email: s_rezayi@razi.tums.ac.ir or Sorayya_rezayi@yahoo.com

and organizational and the people challenges [1, 2]. Growing evidence indicates a well-trained medical informatician workforce can be suggested as a skilled person [3]. The demand for medical informatics education goes beyond IT professional education [4]. However, in some developing countries, the academic field of medical informatics still does not have a precise definition and educated people in this field do not have a suitable job rank and guarantee. Lack of recognition of the skill requirements and abilities of medical informatics graduates could be the reason [5, 6]. This study aimed to determine the skill requirements and capabilities of medical informatics graduates and distinguish the application areas of the field and job positions.

2. Methods

This project was planned and directed by members of the Iranian Association of Medical Informatics (IRAMI). This project was carried out from October 2019 to January 2021 in two main phases in Iran. In the first phase of the study, the initial draft was created by nine members of IRAMI and its validity and reliability were confirmed. Medical informatics professionals from throughout Iran presented their opinions regarding the questionnaire. Also, articles, and curricula related to Iran and other countries were reviewed and recent related papers and documents in PubMed, Web of Science, Google scholar, and Websites of the International Medical Informatics Association were checked. Afterwards, in five focus group meetings with the presence of five Medical Informatics professionals, common data elements were identified and aggregated in the form of an initial draft. The initial draft consisted of: 1) Demographic information, 2) Main domains of the medical informatics practice, 3) Skills required for graduates, 4) Knowledge required for graduates, and 5) Job opportunities. The first part included demographic information (9 questions), the second part included specialized items (78 questions) and the third part included job opportunities (11 questions). Next, the initial draft was assessed by nine independent medical informatics professionals to determine its face and content validity, and reliability. The questionnaire was designed electronically and distributed via social networks. The questionnaire link was also provided to all Medical Informatics lecturers at universities via email. Descriptive statistics and frequency distributions were calculated for the variables with SPSS ver.16 software.

3. Results

A total of 80 participants completed our survey questionnaire. 55% of respondents were females, and the Average age of respondents was 33.64. Most participants (36.25%) had a master's degree, and 26.25% had a Ph.D. Most of the job positions of medical informatics specialists in Iran are managerial and technical (28%) and faculty members (26%).

The results of the survey analysis are shown in Table 1. This study confirmed items with an average of 4 and higher. It should be noted that the teaching abilities were answered by experts who had teaching experience, and their number was 67 people. Out of the 78 items examined, 66 items were approved. According to experts, 12 items were

not approved and removed, marked in orange on the table. The highest number of unapproved items was related to Managerial skills and knowledge.

Table 1. Questionaries' items in two categories: the above-average score in white and the less-average score in orange.

Items			Items
1. Research Knowledge	1.1. Ability to determine research topic and question and research projects	6.Skills and knowledge in the field of medical informatics	6.1. Ability to understand and recognize specialized terms in the field of medical informatics
	1.2. Ability to define research methodology		6.2. Full knowledge of different types of health information systems
	1.3. Ability to perform quantitative analysis in research		6.3. Familiarity with the concepts of creating, structuring, analyzing, designing, and implementing health systems (electronic records, health information systems, hospital systems, etc.)
	1.4. Ability to perform qualitative analysis in research		6.4. Recognize and apply health information systems standards (e.g. electronic health records)
	1.5. Continuous improvement of scientific information in the field of specialization		6.5. Familiarity with disease classification systems (e.g. ICD-10 and ICD-9-CM)
	1.6. Ability to perform statistical methods to analyze and interpret research results		6.6. Familiarity with sciences such as biometrics, epidemiology, and research methods in the field of health
	1.7. Ability to perform review and meta-analysis studies and familiarity with meta-analysis tools		6.7. Familiarity with basic concepts and applied computing (including sensor-based technologies, inclusive health systems, and mobile health)
	1.8. Ability to apply correct thinking and group management techniques such as Delphi		6.8. How to implement different decision support systems and their application in patient management
2. Education and teaching skills	2.1. Ability to set educational goals		6.9. Recognize and apply the concepts of data engineering and data sciences (data mining methods, machine learning, machine vision, knowledge discovery, and production of scientific hypotheses)
	2.2. Ability to guide and evaluate students		6.10. Familiarity with personalized medicine
	2.3. Ability to design curricula		6.11. Ability to specify disease registry data elements
	2.4. Possess knowledge related to the field of teaching		6.12. Familiarity with the concepts of big data and their analysis
	2.5. Being Up-to-date and familiar with the latest methods and new teaching methods		6.13. understanding of ontology concepts
	2.6. Ability to evaluate student projects and evaluate the progress of projects		6.14. Familiarity with IoT applications in the field of health
	2.7. Ability to provide the latest educational content		6.15. Familiarity with the applications of virtual reality and augmented reality in the field of health
	2.8. Ability to teach how to present the results of scientific materials and completed projects		6.16. Familiarity and ability to use artificial intelligence techniques

3. Individual skills and knowledge	3.1. Possess planning skills		6.17. Familiarity with evidence-based medicine concepts
	3.2. Have the skills to communicate with others and interact with different people		6.18. Familiarity with the concepts of telemedicine and its applications and applying telemedicine approaches
	3.3. Having the spirit of cooperation in scientific projects		6.19. Ability to evaluate the effectiveness of systems
	3.4. Familiarity with the seven ICDL skills		6.20. Recognize and apply the concepts of electronic health and telematics
	3.5. Self-learning ability and interest in learning		6.21. Familiarity with Bioinformatics (modeling and analysis of biological data)
	3.6. Have a business attitude	**7. Specific skills and knowledge in the field of medicine, health organizations**	7.1. Familiarity with diagnostic and treatment strategies and guidelines
4. Managerial skills and knowledge	4.1. Policy management, development, and implementation of procedures		7.2. Familiarity with medical necessities
	4.2. Development, improvement, and budget management		7.3. Familiarity with medical terminology
	4.3. Debate and negotiation capabilities		7.4. Familiarity with the components of the medical record (medical history, signs and symptoms, treatment plan, initial diagnosis, chief complaint, Progress notes)
	4.4. Organizational Capabilities Emphasis on problem identification and information management		7.5. Understanding the ethical and legal dimensions of medical information
	4.5. Familiarity with budgeting methodologies		7.6. Familiarity with the performance and components of the health system
	4.6. Familiarity with risk analysis methods	**8. Proposed job opportunities in the field of medical informatics in the health system of Iran**	8.1. Clinical Information Systems Manager, Health Information Systems evaluator
	4.7. Familiarity with evaluation and analysis of progress		8.2. Senior Manager of Medical Informatics in Health Care Organizations
	4.8. Team building skills, staff training		8.3. Clinical Data Analyst and Engineer (Data Expert)
	4.9. Skills for designing strategic management and collaboration programs		8.4. Clinical Information Analysis Expert
	4.10. Possess coordination skills		8.5. Consultant in designing, implementing, and executing health information technology projects, consultant and idea maker in health policy implementation teams
	4.11. Familiarity with the organizational foundations of health systems		8.6. Researcher in the field of health and research centers affiliated with universities
5. Technical skills and knowledge	5.1. Familiarity with the concepts of programming and coding systems		8.7. Cooperation in the development, analysis, management, design, and implementation of medical registers in the departments of medical universities and medical centers
	5.2. Familiarity with hardware concepts and systems implementation		8.8. health Informatics Teacher
	5.3. Applying software evaluation methods and information systems		8.9. Starting new businesses in the field of health information technology and startup manager
	5.4. Applying concepts related to data and information architecture (data modeling, development of conceptual models, object-oriented models)		8.10. implementation and programming team's leader

	5.5. Familiarity with the basics of networking and information security (familiarity with the structure of computer networks, network architecture, main models of network architecture, maintenance, and support)		8.11. Supervisor and consultant of outsourced projects
	5.6. Ability to perform systems analysis and modeling (needs assessment, business plan design, stakeholder identification, risk analysis, reverse engineering, process modeling and analysis, prototype construction)		
	5.7. Ability to use management systems and databases		

4. Discussion

The nature of the MI workforce generated difficulties for this practice analysis [7, 8]. There are no comprehensive data on the dimension of the MI workforce. It involves individuals who are coming from an extensive spectrum of educational paths, working in various roles, working in a broad array of environments, at different occupation stages, and represented by many professional associations [5]. Acquiring some skills/knowledges are essential in MI including research knowledge, teaching skills, personal skills and knowledge, managerial skills, technical capacity, skills, and specialized knowledge of the field. It is clear that further than half of the health-care provider's time is spent on information collection and processing them [9]. Based on our comprehensive results, Iranian MIs expreced that they have a good ability in all skills groups (with the average score greater than 4) except managerial skills. According to this study [10], medical informaticians' pragmatic set encompasses numerous researchers and developers whose primary affiliation might refer to many specific fields, such as medicine, decision commentary, software engineering and computer science. Therefore, struggles to accommodate education in or exposure to interdisciplinary work necessitate to consider a theoretical model that illustrates exit competencies and is evaluated by a summative and formative appraisal [11].

Considering the situation of medical informatics in Iran, there are many problems in hiring medical informatics graduates. The lack of a hetrogenious curriculum adjusted with the markt needs has led to professionals in the field not being able to find suitable jobs. They were worried that such a dual degree could be of obstacles if they apply for jobs outside medical informatics. This matter is slightly surprising since graduates from dedicated degree programs in medical informatics seem to gain fair job chances in computer science [12].

5. Conclusion

This research provides a roadmap for medical informatics policymakers in developing countries. This survey can help develop a curriculum, performance evaluations, job descriptions, and career vision for Medical Informatics. Graduates of this field can have job positions in health organizations, technology, research, managerial positions, and even as policymakers by improving their knowledge and capabilities.

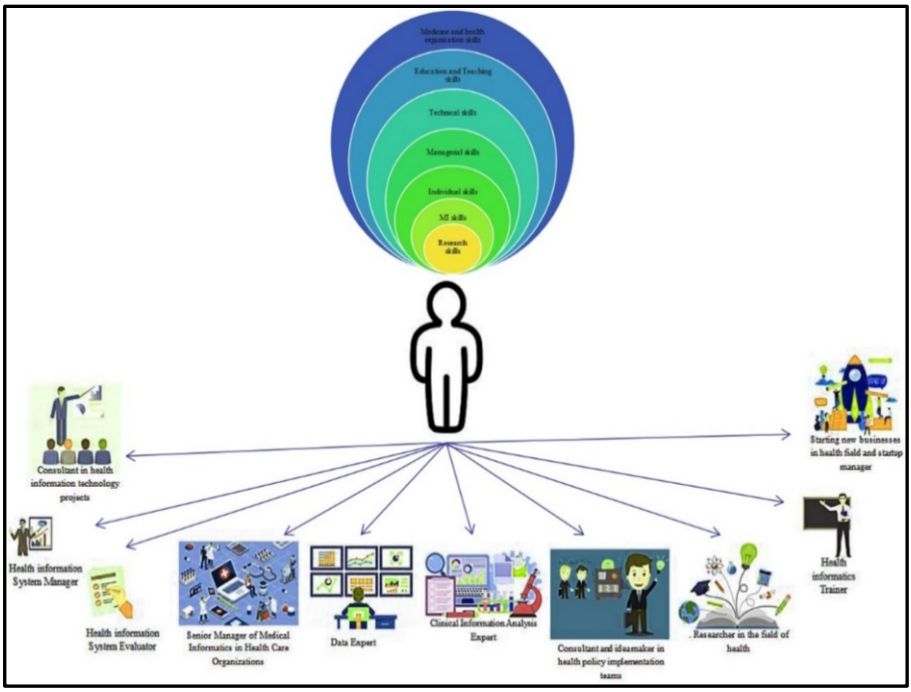

Figure 1. The required skills and job positions for MIs.

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