

# How to strengthen human potential for a successful process of digital transformation of the healthcare system?

Josipa Kern

*Croatian Society for Medical Informatics, Zagreb, Hrvatska*

e-mail: [josipa.kern@snz.hr](mailto:josipa.kern@snz.hr)

*Nihil de nobis, sine nobis*

*Abstract:* Digitalization of the healthcare system requires much more than simply replacing "classic" technologies with digital ones. Changes are necessary in many business processes, especially those in which the active role of health professions and cooperation with other professions in the digitalization process is expected. Therefore, it is necessary for every health profession to be adequately educated for the process of digital transformation. The question of topics, their scope, position in the curriculum and cooperation with health professions working in the practice of health care is open.

*Key words:* digitalization of healthcare; education; health professions

## Introduction

According to the general definition, *digital transformation is a process that begins with the idea of introducing digital technologies into the operations or activities of an organization, institution, area or the entire society and lasts until the moment of complete integration of such technologies with the operations, activities of that organization, institution, area or the entire society.*

It is particularly emphasized that "*digital transformation also includes individuals: it is not enough to introduce digital technology into business, it is also important to educate employees*" (1). The main employees in the healthcare system are precisely healthcare professionals, so their role in the digital transformation of the healthcare system is unavoidable.

*"Don't do anything for us without asking what we actually need"* is a well-known motto used in the Declaration on eHealth to emphasize that "*informatization projects should not be carried out so that users are the last to learn about the project and get to know it when it is finished. It would be correct if the users of the system were involved in its design, in testing during development, and in evaluation and education after completion. These are the postulates of change management.*" That is why it is important that the users of a future system, as well as the future users of that system, are adequately educated for the implementation of changes, that is, for a high-quality digital transformation of the healthcare system.

## What is it all about?

The fact is that the twenty-first century requires digital literacy in all spheres of human life and activity. Thanks to the development of digital technologies and their availability to people through an increasingly high-quality information and communication infrastructure, digital literacy is becoming more and more common in the population around the world every day. However, the twenty-first century, in addition to digital literacy, is also looking for information literacy, which entails "recognizing the right information, knowing an efficient way to find it, structuring information into new knowledge and disseminating knowledge to those who need it" (2). In relation to health and healthcare, information literacy includes the willingness to use digital services and the acceptance of data exchange within the healthcare system. Providing guidelines for the future strategic use of data in European healthcare systems, the Finnish innovation fund Sitra published a Working Document (3) in which it states:

1. Physician education should be supplemented with knowledge on how to use individuals' data to improve disease prevention.
2. Local authorities responsible for health policy should employ a digitally qualified workforce to interpret data by combining different sources in planning new initiatives.
3. Public health and research institutions should use the data they have. This requires the creation of new jobs such as data experts in healthcare institutions.
4. Governments and the academic community should think from a broader perspective when creating new specializations in medical fields, combining medical and technological competences, but also offering courses for doctors to strengthen their expertise in digital health.
5. Hospital managers should improve their organizations' digital competence by promoting positions such as chief clinical information officer or chief information officer.

Like the guidelines of Sitra, the Committee for eHealth of the Croatian Academy of Medical Sciences published the Declaration on eHealth (4) in which it emphasizes the need for:

- eHealth topics for all healthcare professionals,
- topics about the healthcare system for professionals in the field of information technologies (IT professionals) working in healthcare,
- creation of joint teams consisting of IT professionals and health professionals.

On the other hand, given that healthcare professionals (as well as others) handle data in healthcare through interactive healthcare information systems, the normative document HRN EN ISO 9241-210:2019 "Ergonomics of human-system interaction -- Part 210: Design of interactive systems adapted to people" states that such systems should be focused on the needs of those who use these systems, i.e. they should be designed according to human needs (i.e. Human-centered design).

*Human-centered design* is an approach to the development of interactive systems whose goal is to make systems usable and useful by focusing on users, their needs and requirements, and by applying human factors / ergonomics and usability knowledge and techniques. This approach improves the effectiveness and efficiency of the system itself, the better feeling of people participating in the system, user satisfaction, accessibility, and sustainability; and suppresses possible adverse effects of use on human health, safety, and performance (5).

In short, all the mentioned sources emphasize one thing: the education of health and IT professions is needed *to work together* on the development, establishment, evaluation, use and continuous improvement of human-centered interactive health information systems.

In this text, we will limit ourselves exclusively to the education of future health professions for the needs of the digital transformation of the health system.

## Education of health professionals in information literacy

There are three possible levels of education for future health professionals:

- Secondary medical schools and other health-related schools,
- Health polytechnics,
- Medical faculties and faculties of other health fields.

Courses within which future health professionals are educated on the mentioned topics have different names. At medical faculties in Croatia, the usual name of the course is "medical informatics", and so is the title of the corresponding textbook (6).

Leading international associations dealing with the issue of information and communication technologies (ICT) in medicine and healthcare, such as EFMI (European Federation for Medical Informatics) and IMIA (International Association for Medical Informatics) have exactly that term in their name, i.e. "medical informatics ". For the purposes of this text, the name "medical informatics" will be considered a metaphor for the following terms and names:

- Medical Informatics
- Health Informatics
- Biomedical and Health Informatics
- eHealth
- mHealth
- Clinical Informatics
- Public Health Informatics
- Nursing Informatics
- Dental Informatics
- Digital Health.

## Medical informatics in the education of future physicians - what and when?

According to Kern & Fišter (7), many authors long ago recognized medical informatics (MI) as a subject in the medical curriculum (8-14). Sancho and colleagues point out that "our main goals when planning the MI were to give students a general overview of the use of computers in medicine and to instruct them in the use of computers in future medical practice"(11). Coiera pointed out the problems and careful use of medical documentation as a basis for the doctor's work, but "a problem-oriented medical record is only an instrument that only provides information, and the clinician must know when this is enough, and when some other options would be a better choice" (12). Greenes claims that "MI now appears in various curricula as a separate entity" (10). Shortliffe points to the nature of (bio)medical data, saying that "key questions in the field of MI are those relating to the nature of biomedical data and knowledge

and their representation and use in computing systems" and, moreover, "from these recurring themes numerous topics for new research are initiated", such as experiment planning and verification, data and knowledge collection, literature search, diagnosis, treatment planning, user interface design, and teaching (9). Coiera insists on the need for medical students to understand "the dynamic and uncertain nature of medical knowledge" (12). Also, medical students should be able to "maintain up-to-date personal knowledge and skills", "evaluate knowledge against scientific facts obtained through statistics", "interpret uncertain clinical data and deal with artifacts and errors", "structure and analyze clinical decisions in terms of risks and benefits", "apply and adapt clinical knowledge to individual patient circumstances", "access, evaluate, select and apply treatment guidelines, adapt them to local circumstances and communicate and record variations in treatment plan and outcome", "structure and record clinical data in a form appropriate for the immediate clinical task, for communication with colleagues or for epidemiological purposes", and to communicate using "the most appropriate communication method for the given task" (12). One article thus states that MI as a field of study "requires a firm belief that the practice of medicine in 21st century requires topicality, accuracy and literacy with regard to the available and sources of information" (15). Finally, the literature on medical (biomedical or health) informatics education, as well as the Recommendations of the International Medical Informatics Association (IMIA) (16), clearly outline the preferred content of MI education. However, detailed programs with clearly defined lectures, seminars and exercises should be adapted to the specific type of study (medicine, nursing, etc.) and the students' previous experience in using information and communication technology. The next important question is where to place MI in the medical curriculum: at the beginning of the studies (the first two years), in the middle or at the end (the last two years). An alternative view may be that positioning in the medical curriculum is not important at all (13, 17). Another possible challenge is "which MI contents should be included in the level of postgraduate medical education and how to do it" (17, 18).

Kao predmet na integriranom preddiplomskom i diplomskom studiju medicine na medicinskim fakultetima u Hrvatskoj, Medicinska informatika (MI) se predaje u Zagrebu (peta godina studija), Rijeci i Osijeku (druga godina studija). Premda je knjiga Medicinska informatika (urednika: Kern, Petrovečki) službeni udžbenik svih četiriju fakulteta, sadržaji i provedba nastave se razlikuju od fakulteta do fakulteta.

Opis situacije na medicinskim fakultetima može se gotovo jednako preslikati i na obrazovanje ostalih zdravstvenih profesija (zdravstveni fakulteti, zdravstvena veleučilišta, medicinske škole itd.).

## Challenging but still unachieved aspirations in medical informatics education

Health care - treatment and prevention, organization and management, quality improvement and research - presupposes linking a lot of medical and health data from electronic records (medical, health, personal). Modern information technology today has the ability to visualize a lot of data because "a picture is worth a thousand words." This was written about a long time ago (19) and is being written more and more today (20-22).

On the other hand, artificial intelligence methods (data mining, machine learning, etc.) make it possible to connect data of various types (numerical, encrypted, image, etc.) (23-26) and discover new medical knowledge, build or improve existing clinical and other guidelines.

Furthermore, a multitude of different applications (information systems in hospitals, primary health care, public health institutes, etc.) require improvements to existing applications,

adaptation to the needs of health professionals (27, 28)). Evaluation of existing applications is needed, as well as development of criteria for certification of existing and future applications according to human-centered design (HRN EN ISO 9241-210:2019 "Ergonomics of human-system interaction -- Part 210: Design of human-centered interactive systems")

All of the above requires the active role of health professionals, and therefore certain knowledge in medical informatics. Imposing a solution from any side (e.g., from IT professionals, managers, authorities, etc.) cannot result in a quality outcome. Let "Don't do anything for us without asking us" be the guiding thread in the process of the digital transformation of medicine and health care.

In order for health professions to really become active in the process of digital transformation of health care, a core of medical informatics education (specific for each health profession) should be established, based on the consensus of medical informatics teachers with the *cooperation of health professions - practitioners*.

## Open questions

There are several open questions that we must ask ourselves regarding the medical-informatics education of future health professionals. Among others, they are:

1. Is it possible to reach a consensus at the national level that would define a single mandatory subject Medical Informatics in the education of future health professions (doctors, nurses, etc.)?
2. Is it possible to determine topics for medical-informatics education of each individual health profession?
3. Can the scope of topics and the method of implementation of medical-informatics education be agreed upon?
4. Can the appropriate position of medical informatics be determined in the curriculum?
5. Is it possible to establish cooperation with clinical (practical) subjects (in which the student meets patients) in the realization of medical-informatics education?
6. Are there any specific medical-informatics topics that can (or should) be the content of optional subjects in certain education programs for future health professions?

Although these questions and issues of post-graduate medical-informatics education of health professionals are also discussed within the framework of the existing Working Group for the evaluation and development of education in biomedical and health informatics and the possibility of employing targeted experts in the Croatian health system (ELVIS) of the Croatian Society for Medical Informatics, clear answers we still don't have (29).

## References

1. Europska komisija. Predstavništvo u Hrvatskoj. Što je zapravo digitalna transformacija i kakve nas promjene očekuju. Dostupno na: [https://ec.europa.eu/croatia/what\\_is\\_digital\\_transformation\\_changing\\_hr](https://ec.europa.eu/croatia/what_is_digital_transformation_changing_hr)
2. Marković B. Važnost informacijske pismenosti za upravljanje zdravstvenim sustavom Republike Hrvatske. Bilt. Hrvat. druš. med. inform. 2021;27(1):33-42. Dostupno na: [https://hrcak.srce.hr/index.php?show=clanak&id\\_clanak\\_jezik=370871](https://hrcak.srce.hr/index.php?show=clanak&id_clanak_jezik=370871)
3. Hämäläinen H, Malkamäki S, Räsänen I, Sinipuro J, Olesch A. Towards Trustworthy Health Data Ecosystems. How the reuse of data can create new services for the benefit of all. Sitra, Working paper, 2020. Available at: <https://media.sitra.fi/2020/10/08101601/towards-trustworthy-health-data-ecosystems-2.pdf>
4. Deklaracija o eZdravlju. Dostupno na: <http://www.amzh.hr/wp-content/uploads/2021/05/Deklaracija-o-eZdravlju-Prva-revizija-1.pdf>
5. HRN EN ISO 9241-210:2019 „Ergonomija interakcije čovjek-sustav -- 210. dio: Dizajn interaktivnih sustava prilagođenih ljudima“. Dostupno na: <https://repozitorij.hzn.hr/norm/HRN+EN+ISO+9241-210%3A2019>
6. Kern J, Petrovečki M (ur). Medicinska informatika. Zagreb: Medicinska naklada 2009.
7. Kern J, Fišter K. Medical Informatics Meets Medical Education: the Croatian Experience. EJBI 2011; 7(2):58–63. Dostupno na: <https://www.ejbi.org/scholarly-articles/medical-informatics-meets-medical-education-the-croatian-experience.pdf>
8. Hasman A.: Description of Blockcourse in Medical Informatics. Methods Inf Med 1989; 28(4), pp. 239-242.
9. Shortliffe E.: Medical Informatics meets medical education. Medical Technology. SMR 1999; 1(1), pp. 1-3.
10. Greenes R.A., Shortliffe E.H.: Medical informatics – an emerging academic discipline and institutional priority. JAMA 1990; 263, pp. 1114-1120.
11. Sancho J.J., Gonzalez J.C., Patak A., Sanz F., Sitges-Serra A.: Introducing medical students to medical informatics. Medical Education 1993; 27(6), pp.479-483.
12. Coierra E.: Medical informatics meets medical education. MJA 1998; 168, pp. 319-320.
13. Kern J.: Medical Informatics Education – How to Tailor the Course to Given Stage of Student’s Knowledge? AIM 2002; 10, pp. 59-61.
14. Berner E.S., Boulware D.W. :Medical Informatics for Medical Students: Not Just Because It’s There. MEO 1996;1, p. 3.
15. Schwarz B.: The Introduction of a Medical Informatics Course into a Medical School Curriculum. Medical Reference Services Quarterly 2011;30(1), pp. 74-82.
16. Mantas J., Ammenwerth E., Demiris G., Hasman A., Haux R., Hersh W., Hovenga E., Lun K.C., Marin H., Martin- Sanchez F., Wright G.; IMIA Recommendations on Education Task Force: Recommendations of the International Medical Informatics Association (IMIA) on Education in Biomedical and Health Informatics. First Revision. Methods Inf Med. 2010;49(2), pp.105-120.
17. Fišter K, Belani H, Relić D, Erceg M. Biomedical Informatics Workforce in Croatia: Qualitative Analysis of Teachers' Opinions on Needs and Employment Opportunities. Stud Health Technol Inform. 2019 Aug 21;264:1921-1922. doi: 10.3233/SHTI190714. PMID: 31438408
18. Fišter K, Hrabač P, Relić D, Išgum B, Erceg M. Educational Landscape of Biomedical Informatics in Croatia: Who Are the Teachers and What Are Their Attitudes. Stud Health Technol Inform. 2018;255:217-221. PMID: 30306940



19. Powsner SM, Tufte ER. Graphical summary of patient status. *Lancet* 1994;344: 386-389. [https://www.edwardtufte.com/bboard/q-and-a-fetch-msg?msg\\_id=0003mm](https://www.edwardtufte.com/bboard/q-and-a-fetch-msg?msg_id=0003mm)
20. Jin Y. Interactive Medical Record Visualization based on Symptom Location in a 2D Human Body. [https://central.bac-lac.gc.ca/.item?id=TC-OOU-34255&op=pdf&app=Library&oclc\\_number=1032936993](https://central.bac-lac.gc.ca/.item?id=TC-OOU-34255&op=pdf&app=Library&oclc_number=1032936993)
21. Ruan W et al. Pictorial Visualization of EMR Summary Interface and Medical Information Extraction of Clinical Notes. Published in: 2018 IEEE International Conference on Computational Intelligence and Virtual Environments for Measurement Systems and Applications (CIVEMSA). <https://ieeexplore.ieee.org/document/8439958> ; DOI: [10.1109/CIVEMSA.2018.8439958](https://doi.org/10.1109/CIVEMSA.2018.8439958)
22. Škarecki C, Fanton D, Pomper D, Pomper S. Vizualizacija podataka, optimalna platforma za prezentaciju informacija. *Bilt. Hrvat. druš. med. inform.* 2019;25(1):3-15.
23. Davenport T, Kalakota R. The potential for artificial intelligence in healthcare. *Future Healthc J.* 2019 Jun; 6(2): 94–98. doi: [10.7861/futurehosp.6-2-94](https://doi.org/10.7861/futurehosp.6-2-94)
24. Bresnick J. Top 12 Ways Artificial Intelligence Will Impact Healthcare. <https://healthitanalytics.com/news/top-12-ways-artificial-intelligence-will-impact-healthcare>
25. Dumić-Čule I, Orešković T, Brkljačić B, Kujundžić Tiljak M, Orešković S. The importance of introducing artificial intelligence to the medical curriculum – assessing practitioners’ perspectives. *Croat Med J.* 2020;61:457-64. Medline:33150764 doi:10.3325/cmj.2020.61.457. <https://doi.org/10.3325/cmj.2020.61.457>
26. Sonicki Z, Kern J. Is artificial intelligence really a new topic in medical education? *Croat Med J.* 2021;62:200. Available at: <https://europepmc.org/backend/ptpmcrender.fcgi?accid=PMC8107993&blobtype=pdf>
27. Štefok D. Osvrt liječnika na informatizaciju ordinacije obiteljske medicine. *Bilt. Hrvat. druš. med. inform.* 2020;26(1):24-26.
28. Crvenković D. Komentar na program SPP. *Bilt. Hrvat. druš. med. inform.* 2017;23(1):11-14.
29. Fišter K. Radna grupa za evaluaciju i razvoj obrazovanja iz biomedicinske i zdravstvene informatike te mogućnosti zapošljavanja ciljanih stručnjaka u hrvatskome zdravstvenom sustavu (ELVIS). *Bilt. Hrvat. druš. med. inform.* 2020;26(2):44.