

Digital competence – A Key Competence for Today's and Future Physicians

Nilufar Foadi^a and Julian Varghese^b

^aDepartment of Anesthesiology and Intensive Care Medicine, Hannover Medical School, Hannover, Germany; ^bInstitute of Medical Informatics, University of Münster, Münster, Germany

ARTICLE HISTORY Received 22 September 2021; Revised 19 October 2021; Accepted 22 October 2021

Introduction

The current coronavirus pandemic clearly illustrates the increasingly important role of digital technologies in medicine [1]. As a key driver for medical progress digitisation is changing health care in a fundamental manner. Big data, improved analytics, telemedicine and many other technological achievements open up many opportunities to improve patient care and fostering precision medicine [2]. All medical disciplines are eminently influenced by the digital transformation. While several, amongst others political and federal, initiatives drive the progress of digitisation of the health system [3,4], there are different levels of knowledge with regard to digital applications and tools among health care practitioners [5–7]. This article describes the need for the incorporation of digital competencies in medical education and presents a personal view of the authors how the implementation of these competencies in postgraduate training can be achieved.

Preparing physicians for the digital era

Digitisation provides an expansion of opportunities in medicine. From research to patient care – each field of medicine is influenced by the digital transformation [8]. In order to actively participate in the ongoing process of digital transformation and to avoid a passive role physicians need a comprehensive store of knowledge and competencies about digital systems and tools. Physicians spend a significant amount of time using Electronic Health Records for each patient encounter [9,10]. The more digital systems contribute to clinical decision making the more it is crucial that physicians can understand and evaluate advantages and limitations of digital tools, for example of algorithms used by especially artificial intelligence (AI) systems,

which are being increasingly approved for improving diagnostics and establishing precision medicine [11,12]. But the majority of today's physicians has not received sufficient training on digital competencies. Different surveys and studies identified gaps in health-care professional's knowledge for example with regard to principles of data processing and analytics or knowledge about basic characteristics of clinical information systems [13–15]. A survey among more than 200 health professionals being conducted by the Digital Skills for Health Professionals Committee of the European Health Parliament revealed that a large majority reported to have received no training or insufficient training in digital health [4]. A lack of digital competence can lead to medical errors and can weaken the willingness to use and implement new digital tools [10]. This can impede medical progress. Presently systematic mandatory courses covering digital competencies are underrepresented both in undergraduate and postgraduate medical education [16–20]. Therefore there is urgent need to provide basic frameworks of digital competencies and regular courses that prepare physicians for the work in a digitalised health system.

Significant role of medical informatics in the development of training programmes addressing digital competencies

Existing training programmes addressing digital competencies across different countries are heterogeneous in terms of content and structure [21]. In their systematic review of postgraduate curricula Jidkov et al. pointed out that agreed health informatics standards for physicians throughout the EU countries are missing [21]. They performed a mapping analysis of postgraduate curricula using the catalogue of learning outcomes

CONTACT Nilufar Foadi foadi.nilufar@mh-hannover.de Department of Anesthesiology and Intensive Care Medicine Hannover Medical School Carl-Neuberg Strasse 130625 Hannover, Germany

© 2022 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group.

This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

of the International Medical Informatics Association (IMIA) as a reference [21]. On this basis they developed an universal health informatics competency framework for postgraduate health informatics training named “IMIA +” [21]. The study of Jidkov et al. points out that medical informatics frameworks can serve as a basis for structured integration of digital competencies in postgraduate training [21]. They are also a comprehensive foundation for the development of undergraduate curricula [22,23]. A lack of physicians’ knowledge with regard to informatics, in particular medical informatics essentials, and regarding the aspect what digitisation exactly means can build a barrier to deal with digital technologies in detail and to take a proactive role in their implementation [24]. Since the beginning of the computer era medical informatics associations worldwide pointed out to the prominent role of informatics subjects “for high-quality practice of medicine” [25]. The IMIA published its recommendations on education in medical informatics in 1999 [26]. The IMIA recommendations emphasise the demand to accelerate the incorporation of medical informatics competencies in medical education [26]. Throughout the last decades the importance of adequate informatics expertise in health care has been recognised [27]. In 2015 the German Federal Ministry of Education and Research (BMBF) launched the medical informatics initiative as a largescale programme with a broad scope of goals. Amongst others, it pursues comprehensive efforts to strengthen research, teaching and education in the field of medical informatics. Courses addressing digital competencies and specialisation tracks are offered to medical students and physicians. However up to now worldwide undergraduate and postgraduate curricula are lagging behind in the systematic integration of digital competencies [16–20]. In German medical schools the discipline of medical informatics often is under-represented in the undergraduate curricula [28]. While the IMIA recommendations provide a general and broad framework, concrete competency-based learning outcomes relevant for prospective physicians were consented by the working group “Medical Informatics (MI)-Teaching in Medicine” of the German Association for Medical Informatics, Biometry and Epidemiology (GMDS) [29,30]. The learning outcomes of this competency-based catalogue have been integrated in the recently revised National Competency-based Catalogue of Learning Objectives in Medicine (NKLM) [31]. The NKLM represents the official qualification framework for undergraduate medical education in Germany. With the explicit inclusion of these learning outcomes the groundwork for the incorporation of digital

competencies in the undergraduate courses at German medical schools has been established. Now medical schools face the task to systematically integrate these learning outcomes in their curricula [22,23,28].

Basic competencies which are important for all physicians

There are several competencies which are important for physicians in all medical disciplines. To use data to their full potential physicians need to know how digital data can be turned into meaningful information. As provided by the discipline of medical informatics a precise view of the differences between data, information and knowledge and the relationship between these terms is one aspect which is important for physicians in all disciplines [32]. Furthermore all physicians need to understand how they can ensure high quality of data. Due to the rapid growth of medical knowledge in today’s medicine it is more important to ask the right questions than gathering mere lexical knowledge [33]. Thus, management of medical information and knowledge is becoming more and more crucial. Data literacy and information management constitute an integral part in catalogues and frameworks regarding digital competencies for physicians [23]. This had also been affirmed by the review of Jidkov et al.: it became apparent that the following topics were part of all reviewed postgraduate curricula [21]:,1)Information literacy2) Information systems in supporting patients and the public3)structure design and analysis of the health record including data quality” [21] Based on their scoping review, mapping analysis and expert consultation Jidkov et al. proposed six universal competency domains for all postgraduate physicians:,,1) information governance and security 2) system use and clinician safety 3) digital communication 4) information and knowledge management5) patient empowerment6) emerging technologies“ [21] When it comes to the definition of concrete learning outcomes it is desirable that additional domains such as “regulatory aspects of clinical decision support or artificial intelligence” are also considered [29–31]. Until the implementation of digital competencies in undergraduate curricula is in progress frameworks such as the IMIA + framework [21] and the above mentioned catalogue developed by the working group of the GMDS [29,30] could serve as a structured foundation for postgraduate training of digital competencies.

Discussion

At the beginning of postgraduate training junior doctors are trained how to utilise special software systems for their daily work. But they are not taught

the underlying principles of digital systems which would be necessary to persist in an ever-transforming digital health care system and to enable physicians to advise patients regarding a beneficial and reasonable use of digital tools. Due to the rapid growth of medical knowledge and the fast evolving technological developments physicians need to be equipped with sufficient skills to manage the dynamically increasing medical knowledge and to master sources of information sovereignly [33]. To maintain high quality medicine physicians need to have profound knowledge about data management and structure and quality of digital data [32].

Need for a concerted educational initiative

Several national and EU initiatives have been launched to promote training of medical students and graduates on digital competencies [4]. The need for consistent mandatory courses has been formulated but until now standardised training programmes that are ubiquitously available are still missing. A number of approaches are in a developmental stage and consist of optional courses [34,35]. It can be discussed which is the most suitable way to incorporate digital competencies in postgraduate training. Occasionally medical councils, for example in Germany, offer digital health courses and subspecialty certification in medical informatics for physicians. So far these training programmes are optional. In the UK several institutions are working on the implementation of systematic digital skills training in higher medical education [36]. In the USA (US) physicians can pursue clinical informatics as a medical subspecialty. According to a survey from 2015 one third of 557 medical US students expressed interest in a clinical informatics-related career [37]. But due to the ongoing process of digitisation every physician needs digital core competencies such as data literacy and a basic knowledge about the functional principles of digital systems. Therefore digital competencies should become an integral part of Continuing Medical Education in the form of regular training units. The daily and weekly workload of physicians is high, therefore optional courses addressing digital competencies might not reach the majority of physicians. Especially those physicians who have a rather critical attitude towards digital technologies [7,38] might preferably not choose courses on digital competencies. Basic principles with regard to digital competencies could be taught in form of mandatory courses similar to the way by which „good clinical practice“ courses are provided. Courses could be allocated at the beginning of postgraduate training when junior doctors get familiar

with the use of the software programmes in their workplace. A combination of online courses and workplace learning would be desirable to consolidate the acquired knowledge and skills [38]. For both the implementation and delivery of courses and their design it would be beneficial to include experts in medical informatics and, where appropriate, experts of other related fields. In general, interdisciplinary collaboration of physicians with other disciplines is a prerequisite for high quality medicine in the digital era. Physicians need to collaborate with (amongst others) experts in medical informatics, data scientists and engineers to be able to provide optimal patient care in a digitised health care system and to take an active part in further developments in medicine. Consequently, with respect to the development of medical educational programmes interdisciplinary approaches are regarded as very promising [27]. Over long term medical speciality societies should be encouraged to offer training programmes themselves, which would also give them the opportunity to cover speciality related issues in use of digital information technology. But since there are a number of digital competencies that are important for physicians in all medical disciplines it can be a first approach to develop a uniform structured course at a superordinated level for all medical disciplines. For example medical councils could provide a platform for these course offers. As illustrated by Jidkov et al. [21], a standardised curriculum including basic digital competencies can provide a systematic structure for postgraduate training in all medical disciplines. To determine the concrete learning objectives of such a uniform core curriculum and to identify domains that are relevant in all medical disciplines joint working groups of physicians and experts in medical informatics can be conducive [22,23,27].

Conclusion

Physicians need to take a proactive role and need to be involved in the digital transformation of health care to enable them to keep pace with the dynamic changes in medicine. But since undergraduate and postgraduate education lag behind with respect to a systematic incorporation of digital competencies concerted postgraduate training programmes are needed. Digitisation induces a transformation process in all medical disciplines. The integration of a curriculum covering basic digital competencies which are essential for all physicians might serve as a first approach to pursue the incorporation of digital competencies in postgraduate education. Interdisciplinary joint working groups in which physicians and experts in medical informatics can contribute their expertise and

reflect existing frameworks for digital competencies of physicians to lay a foundation for a standardised postgraduate core curriculum.

Disclosure statement

No potential conflict of interest was reported by the author(s).

References

- [1] Dsw T, Carin L, Dzau V, et al. Digital technology and COVID-19. *Nat Med*. 2020;26(4):459–461.
- [2] Sharma A, Harrington RA, McClellan MB, et al. Using digital health technology to better generate evidence and deliver evidence-based care. *J Am Coll Cardiol*. 2018;71(23):2680–2690.
- [3] World Health Organization. Digital health, Agenda item 12.4, WHA71.7. World Health Organization; 2018. https://apps.who.int/gb/ebwha/pdf_files/WHA71/A71_R7-en.pdf. Accessed 2021 Oct 01
- [4] European Health Parliament. Committee on digital skills for health professionals 2016. <https://www.healthparliament.eu/wp-content/uploads/2017/09/Digital-skills-for-health-professionals.pdf> Accessed 2021 Oct 01
- [5] Kirchberg J, Fritzmann J, Weitz J, et al. eHealth literacy of German physicians in the pre-COVID-19 era: questionnaire study. *JMIR Mhealth Uhealth*. 2020;8(10):e20099.
- [6] Stanford Medicine's 2020 health trends report. The rise of the data driven physician. <http://med.stanford.edu/content/dam/sm/school/documents/Health-Trends-Report/Stanford%20Medicine%20Health%20Trends%20Report%202020.pdf> Accessed 01 Oct 2021.
- [7] Torrent-Sellens J, Á D-C, Soler-Ramos I, et al. Modeling and predicting outcomes of eHealth usage by European physicians: multidimensional approach from a survey of 9196 general practitioners. *J Med Internet Res*. 2018;20(10):e279.
- [8] Konttila J, Siira H, Kyngäs H, et al. Healthcare professionals' competence in digitalisation: a systematic review. *J Clin Nurs*. 2019;28(5–6):745–761.
- [9] Lee Y-T, Park YT, Park JS, et al. Association between electronic medical record system adoption and healthcare information technology infrastructure. *Healthc Inform Res*. 2018;24(4):327–334.
- [10] Rahal RM, Mercer J, Kuziemy C, et al. Factors affecting the mature use of electronic medical records by primary care physicians: a systematic review. *BMC Med Inform Decis Mak*. 2021;21(1):67.
- [11] Giordano C, Brennan M, Mohamed B, et al., Accessing artificial intelligence for clinical decision-making. 2021; *Front Digit Health*. 3:645232.
- [12] Varghese J. Artificial intelligence in medicine: chances and challenges for wide clinical adoption. *Visc Med*. 2020;36(6):443–449.
- [13] Dixon BE, Barboza K, Jensen AE, et al. Measuring practicing clinicians' information literacy. An exploratory analysis in the context of panel management. *Appl Clin Inform*. 2017;8(1):149–161.
- [14] Walpole S, Taylor P, Banerjee A. Health informatics in UK medical education: an online survey of current practice. *JRSM Open*. 2017;8(1):2054270416682674.
- [15] Jimenez G, Spinazze P, Matchar D, et al. Digital health competencies for primary healthcare professionals: a scoping review. *Int J Med Inform*. 2020;143:104260.
- [16] Han ER, Yeo S, Kim MJ, et al. Medical education trends for future physicians in the era of advanced technology and artificial intelligence: an integrative review. *BMC Med Educ*. 2019;19(1):460.
- [17] Shachak A, Randhawa GK, Crampton NH. Educational approaches for improving physicians' use of health information technology. *Healthc Manage Forum*. 2019;32(4):188–191.
- [18] Nazeha N, Pavagadhi D, Kyaw BM, et al. A digitally competent health workforce: scoping review of educational frameworks. *J Med Internet Res*. 2020;22(11):e22706.
- [19] Giunti G, Guisado-Fernandez E, Belani H, et al. Mapping the access of future doctors to health information technologies training in the European Union: cross-sectional descriptive study. *J Med Internet Res*. 2019;21(8):e14086.
- [20] Edirippulige S, Brooks P, Carati C, et al. It's important, but not important enough: eHealth as a curriculum priority in medical education in Australia. *J Telemed Telecare*. 2018;24(10):697–702.
- [21] Jidkov L, Alexander M, Bark P, et al. Health informatics competencies in postgraduate medical education and training in the UK: a mixed methods study. *BMJ Open*. 2019;9(3):e025460.
- [22] Behrends M, Paulmann V, Koop C, et al. Interdisciplinary teaching of digital competencies for undergraduate medical students - experiences of a teaching project by medical informatics and medicine. *Stud Health Technol Inform*. 2021;281:891–895.
- [23] Foadi N, Koop C, Mikuteit M, et al. Defining learning outcomes as a prerequisite of implementing a longitudinal and transdisciplinary curriculum with regard to digital competencies at Hannover Medical School. *J Med Educ Curric Dev*. 2021;8:1–9.
- [24] McGowan JJ, Passiment M, Hoffman HM. Educating medical students as competent users of health information technologies: the MSOP data. *Stud Health Technol Inform*. 2007;129(Pt 2):1414–1418.
- [25] Shortliffe EH. Medical informatics meets medical education. *JAMA*. 1995;273(13):1061.
- [26] Mantas J, Ammenwerth E, Demiris G, et al. Recommendations of the International Medical Informatics Association (IMIA) on education in biomedical and health informatics. *Methods Inf Med*. 2010;49(2):105–120.
- [27] Detmer DE. Interprofessional clinical informatics education and practice: essentials for learning healthcare systems worldwide. *J Interprof Care*. 2017;31(2):187–189.
- [28] Haag M, Igel C, Fischer MR German Medical Education Society (GMA), Committee "Digitization – Technology-Assisted Learning and Teaching"; Joint working group "Technology-enhanced Teaching and Learning in Medicine (TeLL)" of the German Association for Medical Informatics, Biometry and Epidemiology (gmds) and the German Informatics Society (GI). Digital teaching and digital medicine: a national

- initiative is needed. . . In: *GMS J Med Educ.* 2018 351. p. Doc43 doi:10.3205/zma001189.
- [29] Varghese J, Röhrig R, Dugas M. [Which competencies in medical informatics are required by physicians? An update of the catalog of learning objectives for medical students]. *GMS Med Inform Biom Epidemiol.* 2020;16:Doc02.
- [30] Röhrig R, Stausberg J, Dugas M. Development of National Competency-based Learning Objectives “Medical Informatics” for undergraduate medical education. *Methods Inf Med.* 2013;52(3):184–188.
- [31] German Medical Faculty Association (MFT), editor. [National Competency-Based Catalogue of Learning Objectives for Medicine] Berlin, 2015. <http://www.nklm.de/kataloge/nklm/lernziel/uebersicht> Accessed 2021 Oct 01
- [32] Georgiou A. Data information and knowledge: the health informatics model and its role in evidence-based medicine. *J Eval Clin Pract.* 2002;8(2):127–130.
- [33] Cullen R, Clark M, Esson R. Evidence-based information-seeking skills of junior doctors entering the workforce: an evaluation of the impact of information literacy training during pre-clinical years. *Health Info Libr J.* 2011;28(2):119–129.
- [34] Aulenkamp J, Mikuteit M, Löffler T, et al. Overview of digital health teaching courses in medical education in Germany in 2020. *GMS J Med Educ.* 2021;38(4):Doc80.
- [35] Kuhn S, Müller N, Kirchgässner E, et al. Digital skills for medical students - qualitative evaluation of the curriculum 4.0 “Medicine in the digital age”. *GMS J Med Educ.* 2020;37(6):Doc60.
- [36] Reich JLK, Khakhria K. NHS must lead innovation in digital medicine. *BMJ.* 2019;365:l1944.
- [37] Banerjee R, George P, Priebe C, et al. Medical student awareness of and interest in clinical informatics. *J Am Med Inform Assoc.* 2015;22(e1):e42–47.
- [38] Vallo Hult H, Hansson A, Gellerstedt M. Digitization and physician learning: individual practice, organizational context, and social norm. *J Contin Educ Health Prof.* 2020;40(4):220–227. Fall.