Foederatio Medicorum Helveticorum

Digital competences in health

Expectations and requirements to face the present and build the future

Christian Lovis, Manuela Eicher, Serge Bignens
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1 Summary

With the rapid rise of digital technologies, healthcare professionals face the need to continuously adapt their competences in digital health. Such competences should allow healthcare professionals to be comfortable with information and communication technology, artificial intelligence, social networks, apps, and to be able to critically appraise digital health instruments, infrastructures, and their impacts, and becoming more of a co-construction actor in their developments. Such competences should include the understanding of the sociocultural landscape, of aspects related to ethical and regulatory frameworks, to accountability and liability of digital technologies, and about the use and development in the healthcare system. It furthermore requires a consequent and sustainable patient and public involvement at all levels of use and development of digital technologies and their infrastructure.

In this paper, an interdisciplinary expert group summarizes the main current trends, challenges, and opportunities of digital health within the Swiss societal healthcare system and digital landscapes. A specific focus is given to artificial intelligence, as part of digital health, given the extraordinary evolution of that field, including educational challenges.

Based on existing frameworks for the definition of competences in the field of digital health, an overview of the key dimensions for competence development is outlined distinguishing five levels of expertise. The dimensions include digital health project management, digital identities and cybersecurity, information management, interoperability, legal and ethical issues, the digital ecosystem, as well as digital health literacy and self-management support. This work purposely keeps a high ranked umbrella of the discussion, considered the existing international initiatives in the field and its fast-evolving pace.

This paper should enable policy makers and educators to make informed decisions about the development and adaptation of current educational programs on pre- and postgraduate level for healthcare professionals in Switzerland.

2 Introduction

Rise of digital health

Digital health is rapidly gaining importance in healthcare together with the wave of new tools including telemedicine, artificial intelligence, and data sharing platforms. This evolution is increasing the need for healthcare professionals to understand how to use, to master, to critically appraise and to teach digital health, and to have means to acquire competences to participate in the development of digital health instruments.

Public, patients' involvement

Digital health is a cornerstone of leveraging autonomous citizens and patients in their capacity to promote their health and support their own care. As such, actions and promotion of

approaches that allow the involvement of patients and the public should be supported.

New competences, fast changes of the landscape

As a result, new competences should be outlined and made available for the educational path. The ability to adapt to the rapidly evolving digital domain seems critical and is thus expected to impact education and training modalities. In particular, the balance of objectives to be set between pre-graduate, postgraduate and continuous training is increasingly challenged responding to this fast-changing landscape.

Improved and accelerated adaption of the education and evaluation processes

The processes underlying the usual teaching models should be able to be accelerated significantly. It is therefore not just a matter of offering new possibilities for acquiring competences but also of building a capacity to set up rapid and adaptive processes for the entire teaching/learning path, up to the validation of competences. Healthcare professionals shall be comfortable with information and communication technology, artificial intelligence, social networks, apps, and be able to critically appraise digital health instruments, infrastructures, and their impacts.

New landscape around privacy, accountability, and liability

As are the digital health modalities, the European and Swiss landscape around privacy in health is changing fast. Healthcare professionals need to face the changes around data security risks, accountability, and liability to protect patients and themselves from misuse. Being able to analyze health data, to make informed decisions, to use digital instruments to provide safely high-quality care is more and more part of the daily practice of healthcare professionals. Increasingly, this happens involving patients and the public.

Tools promoting collaborative and interprofessional care

The Covid crisis has demonstrated the need to rapidly adapt to changing environments and conditions, to build the capacity to collaborate and share, to interpret health data and to use data analysis tools to identify trends and patterns to support healthcare professionals, the management of the care systems and the supply chain. The use of shared electronic patients/health records is increasingly adopted in the healthcare system globally; even more when moving towards collaborative and interprofessional cares.

Skills ensuring safe, reliable, and evolving environment using digital tools

Healthcare providers should be able to be prepared at best for the use of electronic medical record software, mobile apps, and digital communication tools to share information and data with patients, the larger public and other healthcare professionals. All actors of care pathways will benefit from being able to communicate using digital channels, such as video chat, email, text messages and mobile apps. These digital communication paths are already widely used and have shown their positive and some negative effects on infrastructure, processes, and outcomes of care. Healthcare

professionals are already using digital tools and communication without always properly mastering these tools.

Healthcare professionals face the rapidly evolving landscape of digital health with, for example, the sudden emergence of generative artificial intelligence like ChatGPT®, and the need to continually keep up with the latest trends and technologies. The numerous courses available online for every topic look more like a jungle than an organized and validated resource, needed to work in the digital health era.

Responsible education and sustainability are important drivers

Furthermore, healthcare professionals are invited to critically appraise the development of digital solutions and participate to their development. Those who are in leadership positions regarding development and implementation of new digital interventions are increasingly confronted to ethical and sustainable development perspectives. Those responsible for education and skills development strive to facilitate that healthcare professionals have the skills to evaluate digital solutions regarding their value for the citizen and the healthcare system.

Critical appraising

3 Context, challenges, and opportunities

3.1 The digital revolution

Digitalization is leading the world into the fourth industrial revolution[1]. Digitalization raises gigantic hopes and has already achieved inestimable transformations. However, it has also had unexpected effects, such as the global information sharing allowed by social networks contributing to the raise of complotism, extremism and amplification of the "fake news" phenomenon.

Digitalization in healthcare is often implemented with enthusiasm and hopes more than evidence and experience, ignoring the scientific body of knowledge. Building evidence is often a long and tedious activity which aligns badly with the quick-win trends of the digital world. Nevertheless, there are numerous examples in science and technology demonstrating that building evidence is worth the cost.

Digitalization is a powerful instrument, expected to have powerful effects, without a priori judgement of whether these effects are good, or bad, and according to which measures. The authors of the article *"Is digital medicine different?"* published in 2018 in *The Lancet* warn that digitalization in healthcare can be used to circumvent the safety and quality standards

[1] https://www.mckinsey.com/featured-insights/mckinsey-explainers/what-are-industry-4-0-the-fourth-industrial-revolution-and-4ir [accessed 23/07/2023, 12h58]

that apply to other medical interventions. They also point out that digitalization in healthcare can lead to data confidentiality and security problems.

Digitalization in healthcare is, however, expected to bring numerous benefits such as improving the efficiency and quality of care, improving access to care and reducing costs. For example, digital technologies are expected to improve communication between healthcare professionals and patients, to improve the diagnostic accuracy and the use of resources and to facilitate patient follow-up.

To minimize the dangers associated to digitalization in healthcare, it is important to adopt a balanced approach that takes account of the benefits and risks similarly to all new technologies in the healthcare sector. Healthcare professionals must be aware of the potential risks associated with digitalization in healthcare and take steps to protect patient data and ensure its security. The Swiss education path, such as swissuniversities, the federal and cantonal governments, the academic and professional societies and the FMH must help putting in place an environment to ensure that digital technologies are used responsibly and ethically in healthcare.

3.2 Healthcare at stake

The Swiss health system is widely regarded as one of the best in the world, with around $8000 per capita in 2022, significantly higher to the OECD average of about $5000[2]. It is considered that efficiency can be improved. Regarding digital skills development, there are four main drivers that must be taken into consideration:

3.2.1 Healthcare system challenges

- *Fragmentation of processes:* Switzerland is struggling introducing a chronic care model in a networked vision. In consequence, better understanding about integrated care models with new models of fundings need to be developed. Digital tools are considered as facilitators to support networked care models, and enhanced models of care are promising approaches to better meet the rapidly growing chronic care needs of the Swiss population.
- *Chronic diseases and long-term care needs:* Because of a Swiss health system historically focused on acute somatic medicine, the Swiss system is facing many structural, functional and reglementary barriers to deal with situations that require integrated care approaches and long temporality. While Switzerland has one of the highest life expectancies in the world, the raise of life expectancy is significantly decreasing since a few years. Already today, more than half of all health-related services are used by the quarter of the population over sixty years old. Digital health tools, such as mental health apps and online counseling services, could help address the unmet needs in chronic care by allowing patients to access care remotely. These tools are also expected to improve data collection, analysis and understanding, thus

[2] https://www.oecd.org/switzerland/health-at-a-glance-Switzerland-EN.pdf#:~:text=URL%3A%20https%3A%2F%2Fwww.oecd.org%2Fswitzerland%2Fhealth

allowing policy makers to base decisions on facts and target resources more effectively. Of note, the consequences of a reduction of direct human interactions (e.g., lack of sensomotoric stimulation) and their replacement with digital solutions is little studied to date and should be investigated further.

- *Prevention and health promotion*: In 2019, Switzerland spent an estimated CHF 1.8 billion on health promotion and prevention. Between 2010 and 2019, this expenditure represented between 2.2% and 2.7% of healthcare system costs. This puts Switzerland in the bottom half of OECD countries. There is a growing recognition of the importance of prevention in improving health outcomes and reducing healthcare costs in the long term. Digital health tools, such as health apps and wearables, could help facilitate awareness towards health promotion.
- *Access to care:* Barriers to the access to care exist in Switzerland, such as regional and local differences in resources availability, the so-called medical deserts[3]. Like in most OECD countries, differences in access to care are related to the socioeconomic and educational background and age amongst others. Digital health tools, such as intelligent chatbots, remote monitoring and telehealth, could help minimizing some of these barriers, while making sure digitalization is not creating new societal gaps and inequalities.
- Workforce shortage: Like many other countries, Switzerland is facing a shortage of health personnel affecting all professions. Over 70% of active physicians and 35% of active nurses are trained outside Switzerland[4]. Digital health tools, such as digital monitoring, telehealth and patient empowerment instruments, could help address workforce shortages by allowing healthcare providers to care for more patients through efficiency gain but also through new role distribution among care givers and through active participation of the patient.

3.2.2 Digitalization challenges

- *Speed of change:* The impact, speed, and size of effects of digitalization is impressive. The most recent example is about ChatGPT®, which hardly nobody had heard of in 2021, and which is being considered as a disruptive tool in almost all sectors of industry two years later, and already widely adopted. The overall learning of these last forty years (January 1, 1983, is considered the official birthdate of Internet) is that digitalization is not a new step, it has introduced a constant change, a new way of considering the societal evolution, without pause.
- *Disruption potential:* Disruptive changes have never been so strong and at such rate. Internet, cell phones, big data, AI, large language models, etc., and their impacts such as telework, access to information, conversational agents, etc. The large language models are now putting at-risk white-collar jobs.

[3] https://www.rts.ch/info/suisse/12667258-la-penurie-de-generalistes-en-suisse-retarde-la-prise-en-charge-des-patients.html

[4] https://www.gdk-cds.ch/fileadmin/docs/public/gdk/themen/gesundheitsberufe/nichtun._gesundheitsberufe/versorgungsbericht/Obsan_03_2021_RAPPORT_F_corr_def.pdf

- *Unpredictability:* It is becoming very difficult to predict the pace of scientific progress in several digital fields, but mostly in artificial intelligence. The central attention mechanism was proposed in 2014 by Bahdanau, Cho and Bengio for machine translation, and this led to the first release of the transformer model in 2017.

3.2.3 Societal challenges

- *Rising healthcare costs*: The direct and indirect costs supported by Swiss citizens is the most important challenge facing healthcare today. Digital health solutions could help reaching more efficient and effective care delivery and new role distributions among professionals. Digital health tools improving patients' autonomy and prevention tools able to reduce unnecessary usage of resources are also expected to improve the system's efficiency.
- *Inadequate digital health literacy:* In Switzerland, above half of the population shows inadequate health literacy. According to the Federal Office of Public Health, 72% of the Swiss population has difficulties dealing with digital health information. This includes difficulties to judge the reliability of information and potential conflicts of interests, ability to use digital sources to solve a health problem and judge applicability of the information to each own's situation. Health and digital health literacy are a prerequisite of self-management. In turn, self-management support needs to be tailored and targeted to the level of digital health literacy. For populations with very low digital health literacy, such support cannot be initiated by digital tools, but potentially supported. Thus, offers targeted to the level of digital health literacy would benefit to be included in all applications of digital health tools to improve proper usage.
- *Inequality of access*: Although the legal basis for financing the Swiss health system is based on universal access and solidarity, there are well-demonstrated inequalities adding to the usual factors such as level of education and information, socioeconomic status, vulnerable populations, etc. that impact on access to care and capacity for self-management. There are hopes that digital health solutions may reduce inequalities in access to care by enabling coordinated care processes; facilitate the accessibility of remotely provided clinical decision support at the point of care for all healthcare providers and finally leverage better data collection and analysis.
- *Decentralization*: The Swiss health system is highly decentralized, with responsibility for healthcare provision divided between the federal government, the cantons, the local communities, and the private sector. This decentralization has had many advantages for centuries and is an opportunity, with the help of digital tools, to build further agility and proximity with a more robust, resilient, and scalable healthcare system. Unfortunately, wrong incentives can also lead to fragmentation instead of decentralization, and inefficiencies in the system, particularly in communication and coordination, resulting in wasteful care approaches. Digital health tools, such as electronic health records and health information exchanges, could help improve coordination and communication between different providers and actors in the health system. By enabling better data sharing and analysis, these tools could

> support more efficient care delivery and reduce duplication of services. Digital health tools have also shown to facilitate communication with patients and relatives, making it easier for providers to share information and updates and improving patient engagement and satisfaction. Healthcare technologies can also capture patient-generated health data to provide timely and personalized health information to support decision-making and self-management.

In the face of these challenges, digital health might be estimated as a silver bullet that will solve all the problems. Recent evolution of electronic medical records and telehealth have shown how much the decentralized healthcare system in Switzerland could benefit from the development and adoption of digital technologies, while leveraging the decentralized culture of our country. These technologies have the potential to improve access and efficiency, they also require significant investment in infrastructure and training, and the establishment of a regulatory framework that ensures security, usability, and interoperability. By nature, decentralization is a property of the world, and understanding the value of decentralization could make Switzerland a leading actor of the digital health in the world.

3.3 Artificial intelligence

Artificial intelligence is a subject at itself, driver of disruptive changes at an unprecedent speed in all aspects of society. Data-driven science and its corollaries in machine learning and the wider field of artificial intelligence have the potential to drive significant changes in medicine. However, medicine is not a science like any other: It is deeply and tightly bound with a large and wide network of legal, ethical, regulatory, economical, and societal dependencies. Consequently, the scientific and technological progresses in handling information and its further processing and cross-linking for decision support and predictive systems must be accompanied by parallel changes in the global environment, with numerous stakeholders, including citizen and society. What can be seen at the first glance as a barrier and a mechanism slowing down the progression of data science must, however, be considered an important asset. Only global adoption can transform the potential of big data and artificial intelligence into effective breakthroughs in handling health and medicine. This requires science and society, scientists, and citizens, to progress together.

3.4 Digital health prerequisites

Going through all prerequisites goes far beyond the scope of this paper, and this section, purposely kept short, is, however, present to emphasize the importance of some requirements that are often underestimated.

Infrastructure: Digital health solutions require a reliable and secure infrastructure to operate effectively. This includes high-speed internet, cloud storage and secure data transfer protocols as well as identity management.

Data protection and security: Digital health solutions involve the collection, storage, and transmission of sensitive information related to patients and healthcare. It is essential to ensure that all health data is protected from unauthorized access, hacking and other security risks. Knowledge about principles of privacy, security, trust, accountability, liability is a basic

competence of all healthcare professionals. The overall regulatory frameworks applicable in Switzerland (data protection, research on human subjects, etc.) and in Europe (GDPR, EHDS, IA Act, etc.) are the most relevant framework for this knowledge acquisition.

Interoperability: Digital health solutions need to be interoperable among them and with most of the existing systems and technologies to ensure smooth communication and data exchange between different people involved in the care process and settings. Interoperability in health data can be considered as low in Switzerland, and this is probably a consequence of the absence of conformity assessment or homologation processes, or any other regulatory requirements in favor of interoperability for commercial software available in this sector.

Stakeholder engagement: Successful implementation of digital health solutions requires engagement and collaboration with health system stakeholders, including patients, the public, providers, policymakers and technology suppliers. The shared main driver for digital health should be improvement of outcomes for patients, populations, and the larger public. This needs adaptation of some of the current financial incentives.

Confidence and trust: Digital health solutions are often based on complex algorithms and technical terminologies that may not be understood by healthcare professionals and patients. This might result in distrust in the offers and recommendations provided by digital health technologies. Therefore, effective communication and education about the functionalities of digital health technologies needs to be established. Furthermore, ethical questions related to data ownership, informed consent and decision-making can raise questions about the intentions and motives behind digital health technologies and in turn affect the confidence of healthcare professionals, patients, and the public.

Regulatory compliance: Skills should cover the elements applicable in Switzerland, but also the applicability of these regulations in the field of electronic health records.

Importance of direct human interaction: The implementation of digital health solutions might impede social interactions which are essential to support cognitive competences in elderly populations; hamper sensomotoric experiences via direct human-to-human interaction and increase the risk of mental health problems, for people being socially isolated or experiencing loneliness. There are attempts to simulate such experiences, but it is unclear how far they can have the same effects as direct human-to-human interactions.

In sum, digital competences in health shall leverage the capacity to embrace in a timely manner the potential of digital health, while not intruding unmanaged risks for the health and data privacy of the patients and the public as listed below.

3.5 Risks

Similarly, to the previous section, a full analysis of risks of digitalization goes far beyond the scope of this document. It is thus an overview of the points to be considered when elaborating objectives for digital competences in order to leverage the positive potential of digital health.

Data breaches and cyberattacks: Digital health solutions are vulnerable to hacking and other security risks, which can lead to the compromise of patient data and the disruption of health services.

Misuse of patient data: Digital health solutions collect substantial amounts of patient data, raising concerns about potential misuse or unauthorized access.

Barriers to change: Resistances to changes must be carefully handled and can influence disproportionally the adoption of stakeholders that have to face the needs raised by walking through the phases of change processes. Burden on the organizational and provider level needs to be limited. Implementation research might help to overcome these barriers and reinforce facilitators to implementation of usable digital health solutions sustainably.

Technical issues: Technical issues such as system downtime or compatibility problems can disrupt care and compromise patient safety.

Cost: Implementing digital health solutions is expensive, as it requires significant investment in infrastructure, staff and technology. Change processes usually decrease the performance of an organization during the change process. This needs to be taken into consideration when implementing digital health solutions.

Regulatory challenges: Digital health solutions can be subject to complex and evolving regulations, which can create uncertainties and risks for healthcare providers and vendors.

To mitigate these risks, it is important to engage in rigorous planning and risk assessment, develop clear data privacy and security guidelines, and policies, involve stakeholders, including patients and the public in the design and implementation of digital health solutions, and invest in continuous monitoring, evaluation, and improvement.

4 Competence objectives

This section proposes a high-level segmentation of the competences expected in digital health, with a structured approach, namely the foundations, such as identity management and security, information management and the regulatory framework. On these foundations, a digital ecosystem can be built, an ecosystem that will produce and benefit from knowledge and training. Finally, a project management aspect has been added, given the growing importance of networked care and interdisciplinarity. Purposely, this work has focused on high-level aspects that can be seen as a sustainable umbrella to be further refined in precise, objectively teachable, and evaluable elements. There are several international ongoing initiatives launched to enable the development of digital competencies amongst healthcare professionals, such as the HITcomp initiative funded by the EU Horizon 2020 program with the EU-US eHealth Work project (http://hitcomp.org). The American Medical Informatics Association (AMIA)'s 10x10 initiative which aimed to train 10k professionals in medical informatics has led to numerous formal curricula in the field available online and validated lists of learning objectives. Finally, the European Federation of Medical Informatics (EFMI)'s AC2 initiative (http://efmi-ac2.bmhi-edu.org) provides a

database reporting 1900 universities, approximately 1000 academic programs in the domains related to Biomedical and Health Informatics, including Bioinformatics and Biomedical Engineering at all academic levels.

4.1 Digital identities and cybersecurity

In a digital world, it can become tricky to know who is really the person you are communicating with. As communicating with another person than the one you think you are communicating with, by accident, by mistake or bad intention of that other person, can lead to breach in data protection or other very negative impact, it becomes necessary to know and understand the basics in digital identity and to be able to apply and evaluate good practices. Further, the healthcare system has also become a target for cyberattacks, which requires more training and awareness of health professionals for safe behavior with digital tools, risk management and mitigation and knowing what to do in case of evidence of attacks.

To know - what a digital identity is, - the different solutions for two- factor authentication.	To know that - some digital identities are self-declared with little trust, - others are issued and controlled by a certified organi-zation or authority.	To know that Switzerland is currently working on an official electronic ID which would be governed by the state. This ID is not available yet.	To understand the high risks of exchanging electronically health data with a person whose digital identity you are not sure of.	To be able to establish a system that allows others to identify themselves with a trustful digital identity
To know how to get yourself a digital ID from a well-known, trusted and certified ID provider.	To know that you can only be certain that a person communicating electronically with you is really the one he/she claims to be, only if his/her digital ID comes from an ID provider that you trust.	To know - what a digital certificate is, - that certificates can be linked to a digital ID, - that certificates can be used to encrypt emails, to sign emails, to sign documents.	To know that there are various levels of certificates and digital signature. The higher level of certificate (qualified certificate) allows to produce a legally valid digital signature.	To be able to evaluate the trustworthiness of a certificate to digitally sign electronic documents with a valid electronic signature.
To know the main cybersecurity risks: - cyberattack - data loss - business continuity interruption, - loss of data integrity. To know that the human is often the weak point in the system.	To know that continuous information and training is important, - all interfaces with the external world need to be secured, - password and card/badge/token management must be trained.	To be able to conduct a risk analysis. To know when to ask for a security audit and to be able to do the follow-up. To know what a business continuity plan is and the importance of a backup strategy.	To be able to conceive: - a plan (“who does what in which order.”) In case of cyberattack, a communication strategy ready in case of the same event.	Being able to do or to order a risk assessment.

4.2 Information management

There is a large amount of data in healthcare, however, little usable. One of the challenges is because, while a lot of data is typed and organized in models, these models are often not explicit, and their semantics is not formalized. As a result, it gets very challenging to merge different sources. Explicit semantics is the most important single cause for bad *interoperability between different systems*. Another challenge is the life cycle management of all aspects pertaining to data: the data themselves, their structures and models, their metadata and references, etc. For example, a given drug ID used in 2005 might no more be available in the Swiss market in 2023. Nevertheless, the existence of that ID must be preserved in time to ensure *interoperability between different temporalities.*

To understand the difference between data and meaning of data (semantics).	To understand the meaning of data types and data models.	To understand and apply the major layers applied for the Swiss shared electronic patient record (EPD) to achieve interoperability.	To understand and apply the major layers applied for the Swiss Personalized Health Network (SPHN) to achieve interoperability.	To be able to drive projects based on reliable and sustainable information management life cycle.
To understand the difference between data and metadata.	To name international relevant data models.	To understand and explain what information management is.	To understand and explain the impact of temporality on information management.	To explain and teach the concepts of data, information, and their life cycles to reach interoperability and information conservation and reuse.
To name some international knowledge references to describe meaning (semantics) of data.	To understand the dimensionality of data and knowledge sources.	To be able to apply semantics and data models.	To be able to use information-management-driven systems.	To participate to the design and development of systems based on information conservation and reuse.

4.3 Interoperability

Data exchange between health professionals and with patients is a necessary process capability to address many of the challenges exposed in chapter 3. It may sound simple to make an information known by A available to B. However, it remains a significant unresolved challenge. It is all about understanding and exchanging meanings. Without the representation of meanings, there can be no communication of meanings, and thus no interoperability. Semantics is the cornerstone of the message, while technology is the envelope and the carrier.

To know that to assure an unambiguous and common meaning of data exchanged between computer systems semantic interoperability must be assured. To know that a chosen semantic allows to exchange an information with a value and units, and that further systems that will read that value will know how to interpret it.	To know widely used international standards, such as SNOMED CT, ICD10 or LOINC.	To be aware of the risks and consequences when being confronted to a case where data exchange is agreed upon based on a nonstandard and only bilateral valid agreement on the meaning of each data field.	To be able to evaluate which semantic standard to use for which exchange of information, or to be able to have a discussion with technical partners advising on such a choice.	To be able to participate in working groups working on extensions of semantic standards.
To know that actual and further decision support systems based on data need as input data in a defined semantic format and usually according to an international standard.	Understand the importance of using semantic standards that allow data exchange and interpretability without any further human-centric documentation of structures and meanings.	To know that it might take more time to agree about a semantic standard than to take the shortcut of a proprietary coding or free text representation, but that this investment is necessary for an efficient and error-free reuse of that information.	Understand the need for regulatory enforcement of semantic and technical standards to alleviate the burden of health professionals/organization seeking IT products on the market	To be able to participate in working groups working on the selection of semantic standards in the frame of regional or national multi-stakeholders' projects.
To know that for data to be exchanged between	To know the existence following		To be able to evaluate which interface standard to use for which exchange of information, or to be	

computer systems technical interfaces have to be defined. To know that there are well-known and used international standards.	international standards such as HL7, FHIR or OpenEHR.		able to have a discussion with technical partners advising on such a choice.	

4.4 Legal and ethical landscape

Healthcare professionals must be aware of the ethical and legal implications related to digital health, including issues related to patient consent, data privacy, and regulatory compliance. They must be able to apply ethical and legal principles in digital health technology development and implementation.

To apply the general ethical principles to the use and management of digital health technologies.	To refer to the professional bioethics codes when confronted to ethical challenges related to digital health in the organization.	To contribute to the organization and conduct of ethical decision-making processes related to digital health.	To contribute to the development of bioethical standards in the organization.	To lead to the development of bioethical standards related to digital health.
To know and apply principles of informed consent when gathering, using, or sharing data.	To conceive a process collecting the patient consent.	To contribute to de development of informed consent forms and collection.	To contribute to the development of guidelines/standards related to the informed consent in digital health.	
To know the general principles of data protection, privacy, and informed consent to define personal, pseudonymized and anonymized health data and to know its consequences for data sharing.	To refer to organizational legal and regulatory requirements related to the use, access, and disclosure of sensitive health information and other health data.	To refer to the legal frameworks related to digital health and the general principles of data protection, privacy, and informed consent (Federal Act on Data Protection and Human Research Act).	To contribute to the development of legal frameworks of data protection, privacy and informed consent.	

4.5 Digital ecosystem (or data exchange platform)

Actors of the healthcare system, such health professionals with multiple roles and patients, need to exchange information in multilateral ways. This could be for a clinical pathway spanning over several organizations or the follow-up of complex chronic patient by multidisciplinary teams, to mention just two concrete examples. For such a system to be operational many rules, processes and technical components must be put in place. Investment and recurring cost must be covered. Such data exchange platforms must be seen as ecosystems. When how and why to participate to a data exchange ecosystem needs the following skills:

To know the definition of data ecosystems and to be able to name a few, especially around the Swiss Shared Electronic Patient record.	To be able to name a few international data ecosystems.	To be able to answer questions from patients, e.g.: "On which data ecosystem can I share information with you?"	To be able to advise a patient to join a particular data ecosystem.	To know the legal, ethical, commercial data sharing policies of the main data ecosystems operated in Switzerland.
To know that data ecosystems are networks and actors that contribute to data collection, transfer, and use.	To know that data ecosystems have rules for: - onboarding - authentication - exchange format - accesses control - using data - processes - traceability.	To be able to compare data ecosystems.	To be able to follow the development and evolution of the main data ecosystems operated in Switzerland.	To be able to evaluate the services, the value, and the risks of a data ecosystem.
To know that care providers, labs, suppliers, patients, researchers, and insurances can be part of such network.	To know that data ecosystems have their own governance: - financing rules, - access rights, - secondary use, - data protection, - terms of use of applications.	To understand that there is a benefit to receive, access and use data. There is a cost to enter, send, share data.	To understand the details of the term and conditions for participating as a health professional to a data ecosystem.	To be able to participate to the creation or governance of a data ecosystem.

4.6 Digital literacy and self-management

Patients with limited digital literacy often lack the skills and the knowledge to achieve optimal self-management. Assessment and promotion of digital literacy and self-management is thus an integral part of digital competences of healthcare professionals.

To be able to evaluate the level of digital literacy and self-management of patients and families.	To know how to expand the use of electronic health record to evaluate the digital literacy and self-management capacities of patients and their families.	To be able to perform screening, assessment and intervention of digital literacy and self-management capacities of patients and families supported by digital tools.	To know how to integrate different electronic sources and tools to enhance digital literacy and facilitate self-management support.	To be able to develop and promote programs to enable patients to contribute to their healthcare through digital means.
To be able to identify safe and valid sources for electronic digital literacy and self-management support for patients and families. To know how to assist patients and families to access digital information and resources concerning their health and care.	To be able to perform structured digital literacy and self-management support using approved digital tools.	To be able to lead programs that facilitate digital literacy and self-management of patients and families.	To be able to lead quality improvements to digital health literacy and self-management support.	To be able to explore digital methods to improve the healthcare experience and empower patients to become partners in the care process.

4.7 Digital project management

Successful realizations of digital projects in healthcare need an excellent understanding and communication between the persons in charge of the implementation with a rather technical background and the persons representing the future users with a rather caregiving background. It is therefore not only mandatory that technology providers understand healthcare issues well but also of great importance that health professionals take and assume, with the necessary skills, their role in all phases of such projects. Health professionals should also be able to do cost-benefit analysis of digital solutions, to assess what means and resources can and should be invested.

To know that a digital solution has a life cycle with different phases.	To know that to address large projects there are several methodologies, such as “agile development.”	To be able to do a project follow-up on progress, resource consumption, quality reviews. To be able to do a risk analysis, and plan for mitigation measures.	To be able to plan a project, with deliverables, milestones, deployment steps, evaluations. To be able to set up a project organization and governance.	To be able to manage the portfolio of multiple projects.
To know the difference between “make” and “buy.”	To be able to roughly evaluate the budget and time needed for a project. To be able to conduct a value analysis, what is the targeted utility, how can it be evaluated.	To be able to elaborate a training plan. To be able to conceive and/or execute a test plan.	To be able to elaborate a deployment plan. To be able to specify the support needed.	To be able to conduct a procurement process with the help of the experts.
To know and understand the important role of the entity defining what the solution should be and should do, in some methodology this role is named “solution owner.”	To be able to participate actively in workshops defining the processes that will be digitized. To be able to participate actively in workshops defining the functionality, the data model, the data flow, the access to data, the data processing, needed to cover the defined processes.	To master the process of requirement engineering which consists of the planning, the leading, the documentation and the validation of the definition of the processes and data management. To know the tools for process modeling and data flow modeling.	To be able to lead projects from concept through realization to operation phase.	To be able to scale the deployment of a project implemented for a defined perimeter to a product ready to be marketed.

4.8 Artificial intelligence

Artificial intelligence raises very specific challenges in the current landscape due to its incredible recent and fast development, as well as adoption in all parts of society, and of course healthcare. The table below is an attempt, as of June 2023, to summarize the challenges, benefits and potential risks of artificial intelligence (AI) in medicine for medical education and continuing education. The references provided can be used as a starting point to explore each topic further.

This table is built differently from the others mainly due to the very recent developments in major aspects of artificial intelligence, mainly *Transformers,* whose modern version used in large language models was first published in 2017 by Ashish Vaswani et al., Google Brain team.

Category	Challenges	Benefits	Risks	References
Teaching	1. Adapting curricula to include AI training and skills related to the use of AI in medicine.	1. Improving medical education by integrating AI, enabling medical students to develop a thorough understanding of the principles of AI and its application in medicine.	1. Lack of resources and experts to teach AI in medicine, which can lead to a knowledge gap between educational institutions.	S. K. Agarwal et al. Artificial intelligence education in medical education: a narrative review. Medical Education Online, 25(1), 1830954 (2020).
	2. Integration of AI into teaching methods, such as the use of simulations and virtual reality systems to improve the learning and practice of medical skills.	2. Practical, immersive training using virtual environments, enabling students to develop clinical skills before treating real patients.	2. Risk of over-reliance on simulation and lack of exposure to the real challenges and variations of medical practice.	L. R. Gagnon et al. Artificial intelligence in medical education: Perspectives for the future. Medical Teacher, 42(10), 1097-1102 (2020).
	3. Include ethical considerations related to the use of AI in medicine in the medical curriculum, in order	3. Raising awareness among future doctors of the ethical issues associated with	3. Risk of lack of time and priority given to ethics in busy teaching programs, which may lead to	R. L. McNamara et al. Preparing medical students for the impact of

	to make students aware of the issues of confidentiality, algorithmic bias and professional responsibility.	AI, encouraging the responsible and considered use of AI in medicine.	insufficient training on the ethical aspects of AI in medicine.	artificial intelligence technologies on future clinical practice. Medical Teacher, 42(10), 1092-1096 (2020).
Medical practice	1. Integration of AI into electronic medical record (EMR) systems and clinical decision-making systems to improve the accuracy of diagnoses and treatment plans.	1. Improved clinical decision-making through accurate analysis of medical data, leading to more accurate diagnoses, personalized treatment plans and improved patient outcomes.	1. Risk of over-dependence on AI systems, which can lead to diminished clinical skills and blind trust in AI recommendations.	J. P. McNair et al. Artificial intelligence in healthcare: Anticipating challenges to ethics, privacy, and bias. Journal of Clinical Oncology, 38(16), 1844-1849 (2020).
	2. Automation of administrative and repetitive tasks, allowing doctors to focus more on direct patient care and improving the efficiency of clinical workflow.	2. Reduced administrative workload and time spent on nonclinical tasks, allowing doctors to spend more time interacting with patients and providing direct care.	2. Risk of job substitution for certain medical roles, particularly those that can be automated by AI systems.	E. S. Miller et al. Physician Perceptions of Artificial Intelligence for Clinical Practice: A Mixed-Methods Study. JAMA Network Open, 2(10), e1914051 (2019).
	3. Using AI to improve medical research, by enabling faster analysis of data, identification of patterns and	3. Acceleration of medical research thanks to AI, enabling advances in knowledge about diseases,	3. Concerns about the quality and reliability of the data used by AI systems, which may lead to erroneous	A. L. Beam et al. Clinical-Genomic Models of Disease. New England Journal of

	discovery of new associations between risk factors, diseases and interventions.	treatments and interventions.	results or false associations.	Medicine, 382(6), 557-565 (2020).
Continuing education	1. Easier access to up-to-date medical knowledge thanks to AI, supporting the continuing education of healthcare professionals and informed decision-making.	1. Rapid access to up-to-date medical information and the ability to keep abreast of medical advances.	1. Possible bias in the training data and algorithms used, which could lead to incorrect or discriminatory recommendations.	M. A. Zadrozny et al. Machine Learning in Clinical Medicine: Introducing the "Super Learner" Algorithm to Improve Diagnostic Evidence-Based Guidelines. PLOS ONE, 8(4), e62784 (2013).
	2. Using AI to tailor continuing education to the individual needs of healthcare professionals, identifying gaps in knowledge and providing tailored learning resources.	2. Improving the relevance and effectiveness of continuing education through customized AI-based programs that meet the specific needs of healthcare professionals.	2. Risk of over-reliance on automated AI recommendations, neglecting individual needs and the diversity of learning approaches.	S. Goel et al. Artificial intelligence in medical education and assessment. Korean Journal of Medical Education, 33(3), 199-207 (2021).
	3. Identify and monitor emerging health trends by analyzing large quantities of medical data, enabling healthcare professionals to keep abreast of new advances and	3. Rapid access to new medical knowledge, encouraging the adoption of best practice and keeping abreast of the latest health trends.	3. Concerns about the confidentiality and security of medical data used by AI systems, particularly when shared with third-party providers.	A. M. P. Feijt et al. Digital games in healthcare education: The design of an e-learning platform on chronic heart failure.

	practice recommendations.			Interactive Journal of Medical Research, 2(2), e11 (2013).

5 Annexes

5.1 Glossary

Artificial intelligence (AI) is the ability of a machine to display human-like capabilities such as reasoning, learning, planning and creativity. AI enables technical systems to perceive their environment, deal with what they perceive, solve problems and act to achieve a specific goal. The computer receives data – already prepared or gathered through its own sensors such as a camera – processes it and responds. AI systems can adapt their behavior by analyzing the effects of previous actions and working autonomously.
Source:
https://www.europarl.europa.eu/news/en/headlines/society/20200827STO85804/what-is-artificial-intelligence-and-how-is-it-used

Competences refer to knowledge, skills, attitudes, and behaviors that enable healthcare professionals to provide quality care in a safe, patient-oriented, and self-reflective manner. Whereas knowledge refers to theoretical and conceptual aspects that need to be understood, skills include technical aspects of care that are usually learned and developed through practical training and practice. Attitudes embrace aspects that are related to values, beliefs and emotions whereas behaviors refer to the action in daily practice that healthcare professionals apply [5].

Data ecosystem is the complex environment of codependent networks and actors that contribute to data collection, transfer, and use.
Source: https://en.wikipedia.org/wiki/Data_ecosystem They can span across sectors – such as healthcare or finance, to inform one another's practices. A data ecosystem often consists of numerous data assemblages.
Source: Wikipedia.

Digital health is a discipline that includes digital care programs, technologies with health, healthcare, living, and society to enhance the efficiency of healthcare delivery and to make medicine more personalized and precise. It uses information and communication technologies to facilitate understanding of health problems and challenges faced by people receiving medical treatment and social prescribing in more personalized and precise ways. The definitions of digital health and its remits overlap in many ways with those of health and medical informatics"
Source quoted from Wikipedia, https://en.wikipedia.org/wiki/Digital_health, accessed 26/03/2023
The broad scope of digital health includes categories such as mobile health (mHealth), health information technology (IT), wearable devices, telehealth and telemedicine, and personalized medicine.

[5] adapted from Albarqouni, L., Hoffmann, T., Straus, S., Olsen, N., Young, T., Ilic, D., … Glasziou, P. (2018). Core competencies in evidence-based practice for health professionals. JAMA Network Open, 1(2), e180281

Digital skills in health is set of skills necessary to be able to deal with the data-intensive technologies in the future care delivery in a safe, patient-oriented, and self-reflective manner.
Source: inspired by the FMH report on digital skills

Digital health literacy is the ability to appraise health information from electronic sources and apply the knowledge gained to addressing or solving a health problem.
Source: Norman & Skinner, J Med Internet Res. 2006 Jun 16;8(2):e9. doi: 10.2196/jmir.8.2.e9.

Health Information Technology (HIT) refers to hardware, software, integrated technologies or related licenses, intellectual property, upgrades, or packaged solutions offered as services that are designed for or support the use of healthcare entities or patients / the public for the electronic creation, maintenance, access, or exchange of health information.
Source: adapted from McGonigle, D. & Garver Mastrian, K: Nursing Informatics, 4th edition

mHealth (also written as m-health or mHealth) is an abbreviation for mobile health, a term used for the practice of medicine and public health supported by mobile devices. The term is most used in reference to using mobile communication devices, such as mobile phones, tablet computers and personal digital assistants (PDAs), and wearable devices such as smart watches, for health services, information, and data collection. The mHealth field has emerged as a subsegment of eHealth, the use of information and communication technology (ICT), such as computers, mobile phones, communications satellite, patient monitors, etc., for health services and information. mHealth applications include the use of mobile devices in collecting community and clinical health data, delivery/sharing of healthcare information for practitioners, researchers and patients, real-time monitoring of patient vital signs, the direct provision of care (via mobile telemedicine) as well as training and collaboration of health workers.
Source: Wikipedia

Telehealth is part of digital health. The focus of telehealth is on the interaction between patients and physicians / healthcare professionals (teleconsultation) or among physicians / healthcare professionals (teleconsult) in connection with medical diagnostics or treatment, whereby the parties involved are not in direct physical contact with each other.
Source: inspired by eHealthSuisse.