

MEDICAL EDUCATION

Digital health competencies for the next generation of physicians

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Abstract

As health care continues to change and evolve in a digital society, there is an escalating need for physicians who are skilled and enabled to deliver care using digital health technologies, while remaining able to successfully broker the triadic relationship among patients, computers and themselves. The focus needs to remain firmly on how technology can be leveraged and used to support good medical practice and quality health care, particularly around resolution of longstanding challenges in health care delivery, including equitable access in rural and remote areas, closing the gap on health outcomes and experiences for First Nations peoples and better support in aged care and those living with chronic disease and disability. We propose a set of requisite digital health competencies and recommend that the acquisition and evaluation of these competencies become embedded in physician training curricula and continuing professional development programmes.

Introduction

The coronavirus disease 2019 (COVID-19) pandemic and the associated loss of face-to-face contact among physicians, patients and colleagues galvanised the implementation of digital systems such as telehealth and virtual wards at an unrivalled pace.^{1,2} Electronic medical records (EMRs) are now embedded in general practice and increasingly across public and private hospitals. The spectrum of digital health (or eHealth) now encompasses EMRs (including MyHealthRecord), e-ordering, e-prescribing, virtual care, e-messaging, e-consults, computerised clinical decision support systems, mobile health applications, remote patient monitoring and artificial intelligence-enabled predictive analytics. Digital health today extends beyond electronic storage, retrieval or transmission of data to the active use of these data in quality improvement, service redesign and knowledge development. The rapid adoption of telehealth and other

synchronous and asynchronous communication channels necessitates rethinking of care delivery regardless of location. The rapid emergence of companies providing consumer access to virtual consultations and prescribing also challenges traditional modes of care.

The case for curricular change within educational institutions

The current clinical workforce is not well trained or equipped to capitalise on the potential benefits of digital health.³ Tuition in ethical, privacy and security issues related to health information systems is also lacking. The UK Topol Review concluded that all clinicians must have a basic understanding of the role of digital technologies in health care, along with practical training in using them to benefit patients.⁴ Digital competencies need to be defined and embedded into professional training curricula, continuous digital health training must be provided at the workplace in tandem with the acquisition of clinical competencies and support must be given to

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Table 1 Physician tasks amenable to some level of digitisation

- **Recordkeeping:** the entry, organisation, quality assurance, retrieval and visualisation of patient care information.
- **Information retrieval:** identifying sources of, searching for, retrieving, organising and visualising information from the literature or from electronic medical records.
- **Clinical decision-making:** providing assistance in making decisions related to diagnosis or intervention.
- **Workflow:** facilitating the organisation, regularisation and optimisation of processes for patient care, administration, management, teaching and research.
- **Imaging and image management:** acquiring, storing, organising and indexing, processing, visualising and communicating medical images (e.g. radiology, dermatology, ophthalmology, echocardiography, electrocardiography).
- **Ordering and results reporting:** requesting and receiving results of laboratory investigations and electronic medication prescribing.
- **Communication:** providing information to or obtaining information from one's colleagues, patients or service organisations.
- **Collaboration:** interacting with other members of the care team or with colleagues and students in teaching and research.
- **Analysis and visualisation:** processing data and information and presenting results in a comprehensible form – may relate to patient care, teaching, administration or research.
- **Learning and teaching:** acquiring or disseminating new knowledge and skills and/or remaining current.
- **Nonclinical tasks:** performing tasks in managing and administering a project, clinic, department, practice or an organisation.
- **Assessment and evaluation:** reviewing results of care processes and outcomes (e.g. clinical audits, performance reviews and benchmarking).
- **Research:** seeking new knowledge through investigations (e.g. clinical trials, case reviews or laboratory experiments).

physicians to create and test new digital health applications.^{5,6}

Australian investigators concur that clinicians are not receiving sufficient education in digital health^{7,8} and universities and professional colleges are not prioritising it adequately in their training curricula.⁹ Where such education is provided, it lacks standardisation and is often too focussed on direct care applications to the exclusion of data analysis and knowledge creation or system and technology implementation.¹⁰

The increasing use of, and demand for, digital health by empowered consumers¹¹ also necessitates change. Over time, consumers will want to play a larger role in decision-making by gathering information for themselves through websites, downloadable smartphone apps or patient portals. Physicians will need to navigate this transition while safeguarding the integrity of the clinician-patient relationship.

For physicians, many routine tasks can be potentially optimised by digital technologies (Table 1), and surveys show that clinicians want to become more expert in using them.¹² Research suggests that those who use these technologies experience higher job satisfaction and better work-life balance compared with those who do not.¹³ New hybrid clinician roles are also emerging where both virtual and face-to-face care delivery are integrated into work practices, including practitioners in virtual hospitals and programmes, such as the New South Wales Virtual Rural Generalist Service.

When properly implemented, EMRs can improve quality of care, increase efficiency, raise guideline adherence and reduce medication errors and adverse drug events.^{14,15} However, before adopting new digital technologies, physicians must know whether supporting

evidence of clinical utility is trustworthy and ethical, privacy issues have been considered and that these technologies, in augmenting clinical skills, actually improve patient and professional experience, enhance population health and are cost-efficient and environmentally sustainable.^{16,17}

The Australian Medical Council (AMC) has endorsed the inclusion of digital health across the medical curriculum. In partnership with the Australian Digital Health Agency (ADHA), the AMC has produced a Capability Framework on Digital Health in Medicine,¹⁸ and the ADHA has released its National Digital Health Workforce and Education Roadmap,¹⁹ which outlines three horizons for uplifting clinician digital health capabilities, in tandem with changes in health care system design, workflows and funding (Table 2). The AMC and ADHA have called on all professional colleges to embed education in digital health and development of digital competencies in their training curricula and continuing professional development (CPD) programmes. The Australian Institute of Digital Health (AIDH), recognising the need for clearly defined competencies, has created postgraduate clinical fellowships in digital health.²⁰

Digital health initiatives within RACP

In mid-2021, the Royal Australasian College of Physicians (RACP) established a Digital Health Advisory Group (DHAG online Appendix 1) tasked to develop educational and CPD initiatives in digital health for College members, as endorsed by the RACP Clinical Education Committee following a DHAG risk analysis (Table 3). The DHAG reports to the College CPD

Table 2 Digital health capability horizons**Horizon 1: Embedding safe, ethical and effective use of systems of electronic records (now)**

Focus on the basics of digital medical workflows using current technologies, which include EMRs (including MyHealthRecord), secure messaging, telehealth and electronic prescriptions.

Aim is to develop basic skills in safe and ethical use of digital technologies in the delivery of health care and in accessing and using digital information to improve decision-making.

Recognises that patients are also on their own health and digital literacy learning journey and their skill level and preferences in care must be acknowledged.

Ethical approaches to digitally enabled practice mean practitioners must recognise the importance of cultural safety, the limits of technology and when it is important that patients have access to in-person physical care.

Horizon 2: Integrating new technologies and ways of working (2022–2027)

Forward focus on new digital technologies at varying stages of development and application (see Fig. 1), including genomics, advanced robotics, artificial intelligence and 3D printing (Horizon 3).

Aim is for physicians to gain the ability to know how to use these new technologies to support decision-making, the changes to workflows and work practices, how data sets from these different technologies integrate and how such data can be used for more sophisticated data-driven models of care.

Recognises that health care systems and organisations will be more digitally connected, enabling faster and better transmission of information between settings.

Use of these technologies will reshape care functions, create new professional roles and involve new ethical decisions, as well as privacy, cybersecurity and data sovereignty issues.

Cultural respect and safe practice are embedded in this horizon with new and emerging practices that ensure participants are in control of their samples and data and that uses of such data are relevant to the needs of all Australians, especially First Nations people.

Horizon 3: Digital health transformation (beyond 2027)

Focus is on transformation of health care delivery from a 'break and repair' to a 'predict and prevent' system, which is value-based, outcome-focussed and data-driven. Personalised medicine, predictive analytics, consumer self-care and a shift to home and community health care delivery, which has primary care and preventive health as its core, will characterise a sustainable and self-learning health care system that challenges current models and funding of care.

Major move to a world of real-time risk assessment and use of combined data sets that support continuous patient monitoring and outreach as well as virtual care navigation.

3D, three-dimensional; EMR, electronic medical record.

committee and initiates several education and training activities (online Appendix 2).

A key DHAG priority is to formulate a set of digital competencies aligned with both the ADHA Roadmap horizons and the current RACP curriculum standards.²¹ Using Miller's pyramid of skill development,²²

foundational competencies – acquisition of knowledge and understanding of digital technologies – are distinct from hands-on skills or *applied competencies* – the ability to perform specific actions or tasks using digital technologies. The former can be assessed using written or oral assessment modes (e.g. multiple-choice questions and short

Table 3 Risk analysis of including digital health in training curriculum

Risk of not including digital health:

- RACP training is not consistent with current medical practice.
- Adverse reputational impacts for RACP as a physician training organisation.
- Loss of professional credibility in the eyes of digitally competent patients/consumers.
- Delivery of suboptimal care and worse patient outcomes due to inability to appropriately use digital technologies of proven effectiveness.
- Marginalisation of physicians in the development, validation and evaluation of new digital technologies.
- Creation of inequitable digital divides among groups of physicians with resultant compromise in quality of care.

Risk of including digital health:

- Resources, expertise and protected time to update the curriculum may not be available.
- Some fellows may find the updated curriculum disruptive to established methods.
- Additional training requirements may not be accommodated in an already crowded curriculum.
- Perception of reduced emphasis on acquisition of bedside clinical skills as opposed to digital skills.
- Digital curriculum may be perceived as being less relevant to physician competence if formal assessment methods are not included.
- Acquisition of hands-on digital skills may be limited if there is insufficient exposure or access to best practice training environments comprising well-functioning digital workplaces and role models.

RACP, Royal Australasian College of Physicians.

Table 4 Foundational digital competencies in knowledge and understanding

- **Digital health technologies that can be applied to clinical practice administration, teaching and research, as well as the cofactors that make these technologies effective and the concepts that surround these.**
 - Cofactors: change management, work process reengineering, end-user education and training, human resources and organisational restructuring and supportive communication.
 - Need for scientific literacy (i.e. understanding scientific methodology), data literacy (i.e. understanding data sets and data science) and computer literacy (i.e. understanding structures, processes and applications of computerised systems).
 - Local and central information systems (including internet-based and cloud-based systems), software involved and communications technology that connects them.
 - Tools for: personal support (e.g. word processing, spreadsheet and databases); searching, accessing and integrating medical data and knowledge; clinical data management; decision support; clinical performance evaluation and comparison; information sharing with colleagues and patients.
- **The nature of data, information and knowledge.**
 - Types and sources of data, metadata (data describing data), knowledge.
 - Storage, retrieval, organisation, processing and visualisation of data.
- **The nature of how decisions are made and the technologies for assisting physicians in making decisions.**
 - Capabilities and limitations of decision-making support systems; methods for generating and presenting advice, alerts and recommendations; understanding of human cognition and memory and their limitations.
- **The nature and capabilities of EMR systems.**
 - Capturing, organising, indexing, labelling and retrieving data.
 - Data definitions, vocabularies, standards; human–computer interfaces; human factor and ergonomics in using digital systems.
 - Legislative and regulatory requirements around privacy, ethics, security; risks and limitations of such systems.
- **The nature of health care workflows and how humans and digital systems interact in complex, busy clinical environments.**
 - Workflow reengineering to improve workflows, dataflows and human–computer interactions.
- **How systems can better connect individuals to form teams and support team activities.**
 - Digitally enabled professional teamwork and communication with patients.
 - Distributed digital communication systems that connect geographically dispersed members of the care team.
- **The implementation and use of systems.**
 - Clinician obligation to participate in implementation of digital systems.
 - Knowledge of digital system lifecycle from conceptualisation through development, implementation, testing, use and evaluation of impacts, both positive and negative, on users and the organisation.
- **The value and impacts of systems.**
 - Evidence of digital system effects on clinical effectiveness and efficiency, critical success factors and challenges to realising positive impacts.
- **The economics of systems.**
 - Financing and reimbursing use of digital systems (e.g. EMRs and telehealth).
 - Concepts related to budgeting for systems, measuring economic value and return on investment.
- **How systems can support learning.**
 - Learning health care systems at individual and organisational levels and required tools.
- **The context into which systems are introduced.**
 - Organisational culture, fiscal and human resource limitations, staff education and training, operational challenges, users' perceptions, organisational readiness, regulatory and legal issues.

EMR, electronic medical record.

essay answers), whereas the latter are assessed by observing entrustable professional activities (EPAs), i.e. behaviours expected to be routinely performed by RACP members with supervision at a distance. In developing a provisional set of digital health competencies, the DHAG considered current literature,^{23–31} competency frameworks from authoritative sources,^{32–43} expertise of DHAG members and findings from a digital health learning needs survey involving RACP members (manuscript in progress).

A list of foundational competencies is contained in Table 4, a provisional set of applied competencies for Horizon 1 (i.e. competencies needing to be acquired now by RACP members) are listed in Table 5 (for Horizon

2, see online Appendix 3) and a selection of first-round EPAs are listed in online Appendix 4. For a specific horizon, the DHAG grouped the competencies to align and integrate with the themes used to currently structure the clinical competencies in RACP training curricula.

Challenges in integrating digital health into training curricula

Integrating digital health training and assessment into current curricula will face several challenges. First, the curriculum is already crowded and making room for digital health will be contested. Second, competencies and curricula must be crafted with the knowledge that the availability and

Table 5 Provisional set of applied digital competencies for Horizon 1**Medical (digital) expertise:** Ability to:

- Apply technical and clinical terminology as applied to digital health technologies.
- Identify appropriate digital technologies to mitigate or resolve health care problems.
- Use computers and other devices competently, including basic computer skills, touch typing, database and word-processing skills, and using applications and online systems.
- Use and navigate the functions of EMRs and associated feeder systems.
- Use virtual care technologies effectively and efficiently: selecting patients and clinical contexts most appropriate for virtual care and remote patient monitoring.

Judgement and decision-making: Ability to:

- Access, aggregate and cross-reference data from various digital and nondigital sources in generating a comprehensive clinical picture or summary of care.
- Deliver evidence-based practice with the support of information search strategies, digital guidelines, and CCDSS.
- Critically appraise digital health technologies and define when they may be inappropriate, inaccurate, disrupted or nonfunctional.
- Interpret, evaluate and communicate statistical information.

Communication: Ability to:

- Use the most appropriate format of digital discourse (digital etiquette) that does not intrude on, or compromise, the physician–patient interaction (e.g. sharing screens with patients; limiting computer use during difficult and emotional interviews).
- Use digital technologies to support communication and relationships with and between physicians, teams and patients.
- Utilise secure messaging (e-consults, e-messaging and SMS messaging) and web conferencing.
- Use evidence-based digital resources and multimedia (e.g. digital images and infographics) for patient information.
- Retrieve, share and transfer digitised patient data while ensuring data protection and security.
- Differentiate between undercommunication (assuming information can be found digitally by others who will be responsible for taking actions) and overcommunication (alert fatigue and excessive email notifications).

Quality and safety: Ability to:

- Enter accurate, valid and complete clinical data into digital health systems in ensuring its safe and high-quality application to evidence-based decision-making.
- Use digital health systems (EMRs, e-ordering, e-prescribing, imaging systems, referral tools and discharge summaries) appropriate to professional duties and scope of practice.
- Adhere to, reject with reason or modify decision support and alerts as appropriate.
- Critically appraise clinical data within digital systems, including completeness and veracity of data within EMRs, websites and CCDSS.
- Take actions to resolve basic technology problems and disruptions that may compromise safe, quality patient care.
- Apply security, risk mitigation and governance procedures pertaining to digital data, systems, devices and networks.
- Apply cybersecurity strategies, such as email phishing, cookie settings, encryption and so on to prevent unauthorised access to data and software.

Cultural and social competence: Ability to:

- Apply ethical, legal and regulatory guidelines in determining appropriate access, use, disclosure and protection of data to protect patient confidentiality.
- Use digital systems professionally and ethically while maintaining privacy and professional boundaries (i.e. appropriate use of email, social media and digital images).
- Use digital systems in ways that ensure engagement with minority or disadvantaged patients: First Nations peoples, refugees, migrants, LGBTIQ+ community, residents in aged care facilities, prisoners and homeless persons.
- Use digital technologies in ways that do not create or worsen digital divides or health care inequities.

Teaching and learning: Ability to:

- Use digital health technologies and systems to remain up-to-date in knowledge and skills.
- Use and personalise electronic literature scanning services specific to one's learning needs.

Research: Ability to:

- Explain basic descriptive statistics, probability distributions and predictive modelling.
- Formulate clinical questions that can be addressed with different data sources, and work with data custodians and others in defining and accessing required data items and analytical methods to be used.
- Use data from EMR and other digital systems to identify patients eligible for clinical trial participation.
- Evaluate the role, impact and enablers of human–computer collaboration in health care.

Leadership, management and teamwork: Ability to:

- Act to effect change, such as reporting digital health user experiences to relevant line managers or department heads; advocate for change and participate in codesign and user testing processes as appropriate.
- Collaborate with information technology personnel, data and computer scientists in digital health technology development, implementation and evaluation and master, within reason, their language and jargon.
- Identify organisational and human barriers to effective use of digital health technologies and potential methods for addressing these challenges.
- Create a professional culture towards continuous individual, team and organisational learning and development of digital health solutions in response to health care demands.
- Promote open, transparent information sharing and discussion with multidisciplinary teams in working to solve digital technology challenges.

CCDSS, computerised clinical decision support systems; EMR, electronic medical record.

accessibility of digital infrastructures and bandwidth may vary considerably across different clinical settings. Third, sufficient numbers of highly skilled supervisors and mentors are required to provide the necessary education and training across multiple sites. Fourth, competency-based training requires an integrated programme of learning and assessment, which requires programme directors to write learning objectives, select assessment tools and embed digital health into existing syllabi rather than rely on separate stand-alone courses. Fifth, the dynamic and evolving nature of digital health will likely require a 3- to 5-year updating cycle to ensure continued currency and practice relevance of both competencies and curricula.

Options for promoting and evaluating digital health competencies

The AMC, as an accreditation requirement, will expect RACP and other medical colleges to incorporate explicit training and assessment in digital health, and various options are available. Stand-alone certificates or graduate programmes in digital health are offered by various universities and agencies in Australia⁴³ and overseas. Several universities are supplementing these programmes with shorter, more focussed learning opportunities, such as Massive Online Open Courses or microcredentials, with many being developed collaboratively with services and government agencies.⁴⁴ However, these need to be fit for purpose in meeting the specific requirements of RACP training and CPD.

Conferences, workshops, symposia, tutorials, journal clubs, modular courses, toolkits and case-based learning opportunities provided by the RACP, including resources provided in collaboration with the ADHA (available at: Digital health | RACP) can provide exposure to highly focussed subject matter over hours to several days. Although face-to-face instruction in real-time is often preferred for providing hands-on experience with software tools, this may not always be practical, in which case a 'flipped classroom' approach with video online learning environments may be more feasible (i.e. teacher-led in-class instructions replaced with individual homework or group activities).⁴⁵ A mix of targeted, high-value face-to-face and interactive online instruction will likely be needed to support learning at scale.

Web-based software tools comprising discussion boards, email and real-time interactive communication are possible, including online sandpits to trial telehealth and play with dummy EMRs in simulated systems. These platforms can post material, such as documents, slide sets, lecture notes, multimedia and blogs. Teachers and learners can also engage in real-time discussions and Q&A sessions in webinars supported by live-streaming platforms such as Zoom or Webex.

Online special interest forums or Communities of Practice, such as those provided by the RACP and AIDH, can enable shared learning through portals providing open-source, readily accessible (and free) educational materials for developing skills and knowledge in various digital health domains (see online Appendix 5). Such materials can also comprise modules developed by RACP

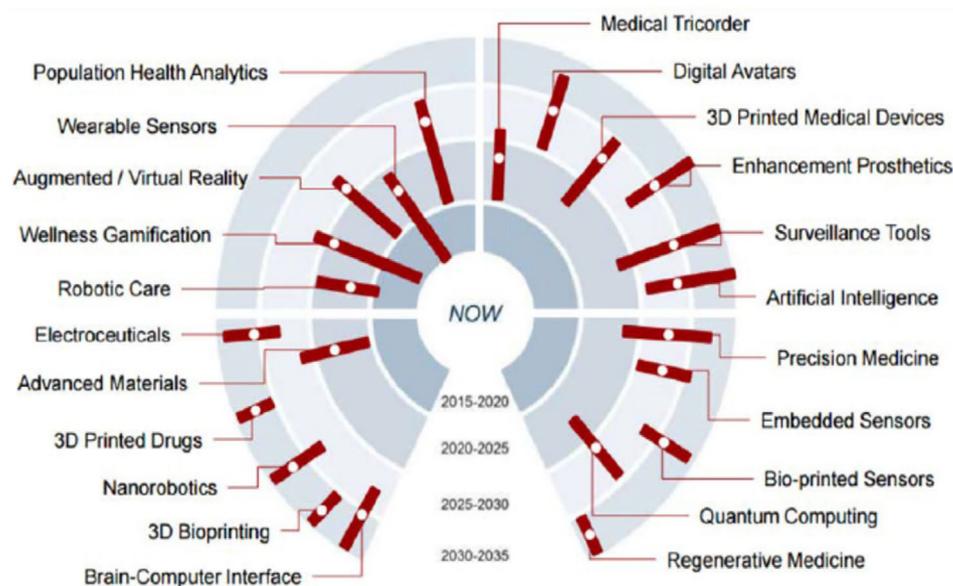


Figure 1 Technology commercialisation and maturation. Frost & Sullivan: <https://ww2.frost.com/>. Bars represent the time horizon for commercialisation and maturation. 3D, three-dimensional.

digital faculty and focus on specific topics such as basic computer skills, EMR systems, ethics and legal issues, data analytics and change management.

CPD programmes can include credited activities that encourage learning and application of digital competencies and self-assessment of impacts on care, and from which members can select those most relevant to their practice (available at: Digital Health CPD Primer [racp.edu.au]; online Appendix 6).

Finally, evaluating digital competencies within training programmes requires reviews of observed EPAs using assessment templates modelled on the one in online Appendix 7. Similar to using miniclinical evaluation exercise templates to assess hands-on clinical skills, these templates could formatively assess hands-on digital health skills, although the number and scope of such exercises required to adequately assess individuals remain uncertain.

Conclusion

If physicians are to practise effectively and equitably within increasingly digitised but resource-limited health

care systems, competence in using digital health technologies that will increasingly transform delivery of patient-centred care is required,

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Data availability statement

All data used to compile this article are contained in the text, tables and references within the article and online appendices.

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Supporting Information

Additional supporting information may be found in the online version of this article at the publisher's web-site:

Appendix S1. Supporting Information