Digital Health & Care Innovation Centre

How to navigate the digital shift in healthcare?

An international review and analysis of frameworks used to support digital working by frontline healthcare staff

dhi-scotland.com

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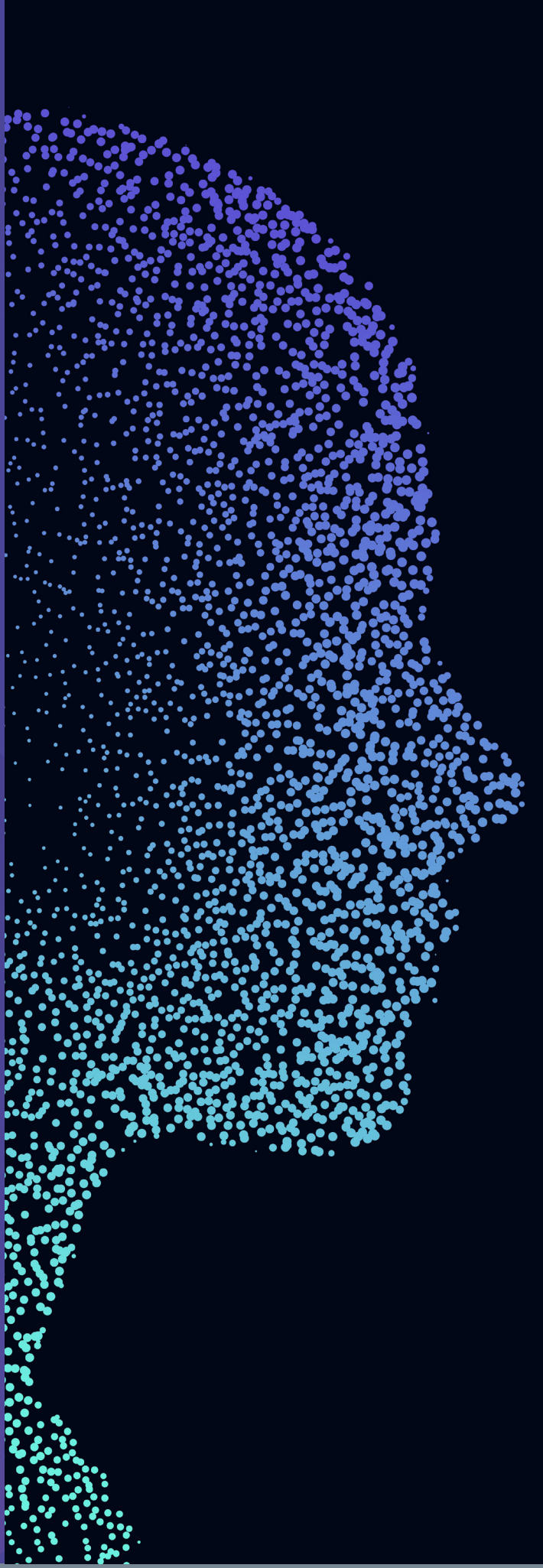

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CEO Foreword

Digital technologies are playing an ever more important role in our day-to-day lives. As these devices become more familiar and user-friendly, there is a risk that we assume that everyone will find it easy to use technology to support what they are doing and that they will have a good experience by so doing. Sadly, this is not usually the case. In the delivery of healthcare around the world, there is an increasing drive towards digital technologies supporting the delivery of high quality, safe and effective healthcare. However, the benefits that such developments can undoubtedly bring requires careful thought and planning.

It is therefore ever more important that we support the workforce tasked with delivering healthcare to develop the necessary digital skills to drive the maximum benefit both for their patients but also for themselves and their colleagues. Organisations around the world have recognised the need to invest in the development of guidance and frameworks intended to support frontline healthcare staff. This review places a spotlight on much of the work that has been done internationally to date, and may help prevent "reinventing the wheel" but also assist in sharing good practice.

Professor George Crooks OBE - Chief Executive Officer

Executive Summary

The digital transformation of health and care started accelerating around 2016, but leapt forward unexpectedly forced by the Covid-19 pandemic (cf. Morrison et al., 2022). Successful digital transformation of health and care require an appropriately skilled workforce. 'Digital skills' have become a burning issue in workforce development discussions, research, Governmental strategies and policies world-wide, and there has been a huge proliferation of literature around the topic. With these, there has also been a hike in published frameworks intended to support digital working by healthcare frontline staff. The purpose of this study has been to make sense of the different frameworks developed to support work in a digitally enabled context, specifically in healthcare; to understand who and what they are for, what their intended purposes and the shared elements across frameworks are.

The study has unfolded through two separate search phases and six distinct sets of analyses of these data, becoming more informed and targeted over time. Each analysis has sliced and diced the data set in different ways, helping us make specific points. The analyses looked at 1) the chronological emergence of frameworks over time; 2) the geographic origins of the frameworks; 3) the genealogy or the relatedness among clusters of frameworks; 4) analysis of target groups for the frameworks; 5) analysis of terminology used in frameworks; and 6) content analysis of selected frameworks.

We identified an evolution and proliferation of frameworks over time; trends, which reflect changing technologies, shifting strategy and policy landscapes, and the increasing digital maturity transforming world of work and activating the emergence of new job roles in health and care.

The review finishes with a small number of recommendations for the selection of a suitable framework to support digital working for frontline staff. The first one is to optimise the assessment of the current digital maturity of the infrastructure and the digital literacy of the workforce to help identify a suitable existing framework to adopt or adapt for use locally.

New frameworks become relevant when new digital innovations emerge and are appropriated for use by healthcare service and delivery. This includes changes in legislation, regulations, and culture, etc.

The review also recommends adopting an agile approach in the development of future frameworks, with a reference to the NHS HEE (2023) AI and Digital Health Technologies framework, which uses archetypes or personas to specify job types instead of strict professional roles.

I - Introduction

Digital health and skills are a messy domain. Googling "digital health and skills" brings up 994 million hits[1]. Digital Health & Care Innovation Centre (DHI) is one of the organisations that wanted to make sense of this domain. An international review of frameworks supporting digital working in health and care was commissioned in September 2022. The work has progressed slowly, like hacking a path through a jungle.

Many other reviews have been conducted on digital skills[2] and digital literacy frameworks generally (e.g., DQ Institute 2019; Oberländer et al., 2020; Tinmaz et al., 2022; Martinez-Bravo et al., 2022) and on the topic of digital skills in healthcare more specifically (e.g., European Health Parliament 2016; Carrasqueiro, 2018; Nazeha et al., 2020). However, fewer reviews have differentiated between different professional categories in the same way as we have done in this study (see Figure 5), which focusses solely on frameworks aimed at frontline healthcare professionals. By this we mean anyone involved in the day-to-day delivery of care, excluding knowledge, information, digital and data (KIND) specialists (cf. Digital Health & Care Institute, 2019), and digital tech and design staff working in health and care (Rimpiläinen et al., 2019). While studies by Brice & Almond (2020) and Pengel et al. (2022) have also focussed on frontline healthcare professionals, these studies have very different coverage from the present study, as they focus on systematic search of academic literature, whereas this study focusses on frameworks in active use.

The purpose of this study has been to make sense of the variety of frameworks developed to support work in a digitally enabled context, specifically in healthcare; to understand who and what the frameworks are for, what their intended purposes and shared elements are. Finally, the report offers recommendations or guidance for when it might it be useful to develop another new framework to support healthcare staff working in a digitally enabled environment, and in that case, what to consider.

The report first presents the background to the study followed by search methodology, before moving on to laying out the six sets of analyses and the discussion of findings. The report finishes with a set of recommendations.

[1] *On the 18th Aug 2023.*
[2] *'Digital skills' is used here as shorthand for 'digital skills / capabilities / competencies'.*

II - Background

In 2021-23, the Digital Health & Care Innovation Centre (DHI) chaired a global group of digital healthcare leaders focussed on examining skills required in the digitally transforming healthcare sector.

The members of the group came from Europe, North and South America, India, Africa, and Australia. Trying to arrive at a joint, global stance on how to approach the question of digital skills in healthcare proved quite a challenge: in one region, the healthcare services were getting ready to start implementing analogue telecare services; in another area, the system was leap-frogging straight into using mobile health devices thanks to lack of legacy systems; while somewhere else, the main interest was on skills required to utilise AI-powered technology as part of clinical practice.

Differences in the digital maturity of healthcare systems around the world are vast, and consequently, the types of digital skills required by staff are on very different levels. What is a global phenomenon, however, is that digital technologies are developing at an ever-faster pace, and that transformation of healthcare is happening everywhere, notably accelerated following the COVID-19 pandemic (e.g., Morrison et al., 2022). In line with this development, there has also been a proliferation of different types of frameworks supporting work in digital contexts aimed at healthcare staff around the globe, ranging from generic frameworks to profession specific ones.

This review emerged from the need to understand this landscape better, and to make sense of the multitude of frameworks aimed at supporting healthcare staff working in a digitally enabled environments in different countries.

III - Methodology

This study is based on rapid review of literature, limited to sources published in English, available online. Two different time frames were used, as explained later. Hence, the search results will be skewed towards the English speaking and western world. The review is not comprehensive, due to the sheer number of frameworks available, but we have striven to include the most prominent ones into these analyses.

Due to the complex nature of the topic, the study has unfolded in two distinct phases, informed by an iterative analysis and assessment of findings helping to focus the research process. The study consists of six distinct, yet complementary, sets of analyses of data. In this section, we present the search processes for Phases 1 and 2 and explain the sets of analyses taken.

Search terms included digital + skill / literacy / competence / competency [3] / capability, in combination with health, care, healthcare, ehealth, nurse, doctor, framework and model. Search engines used included Google, Microsoft Edge, and DuckDuckGo. In addition, citations of relevant sources were screened to identify further relevant documents.

Search Process – Phase 1

The first search (Phase 1) was exploratory in scope. It was not time-limited, and it focused on cataloguing frameworks that could be categorised by application in health and social care, including ones for patients (i.e., citizens or the general public); published by organisations and governments; and aimed primarily for practical use by any professional group in health and care. While the initial trawl of the Internet brought up hundreds if not thousands of hits, with the selection criteria in mind, the Phase 1 search yielded a total of 116 frameworks.

Peer-reviewed articles were excluded from the analyses: these often sit behind published frameworks. We also excluded policy and strategy documents, which set aspirations for frameworks but are not frameworks as such, as well as e.g., news items discussing frameworks.

[3] *Both terms 'competence' and 'competency' are being used in these frameworks, often interchangeably. We have left 'competence' in place, where this is being used by the authors, but otherwise we have used 'competency' in our text to denote a more advanced professional skills that requires training to achieve. Please, see https://www.indeed.com/career-advice/career-development/competence-vs-competency for more information.*

Instead, we focussed on frameworks applicable in practice and aimed at wider audiences. After removing duplicates[4], 57 frameworks were left for analysis. Twenty of these were aimed at frontline staff and data/informatics specialists, and 37 at citizens for the inclusion of 'patients' in healthcare.

This exploratory approach helped us understand the nature and evolution of the frameworks, reflecting the period in which they were published, the available technologies, the digital maturity of the healthcare system at the time, and the required abilities needed for work with digitally supported environment across healthcare. These findings (discussed later) helped inform the second phase of searches and pointed us to a way in which to start thinking about the analyses of the data.

Search Process – Phase 2

The Phase 2 search was more targeted, focussing strictly on frameworks aimed at healthcare staff only, initially including frameworks for any staff category. Furthermore, this search was time-limited to frameworks published in 2018-23, the period when the number of published frameworks started proliferating, as identified in Phase 1. The decision was further backed up by the discovery in Phase 1, which showed that the later frameworks were largely adaptations and refreshed versions of the earlier frameworks, which led us to carry out a genealogical analysis of some of the frameworks.

Focussing on the period 2018-23, Phase 2 search yielded 189 results, partially overlapping results from Phase 1. After removing academic articles (54) and other skills documents (54), including duplicates from the data set, we divided the rest according to the target audience: frontline staff (27); specialist Knowledge, Informatics, Digital and Data (KIND) staff (30), and technical staff (2). As our work progressed, we decided to focus the analysis on frameworks intended for use by frontline healthcare staff only (see Analysis 4 for more information).

Table 1. *Search results published in 2018-23 per type.*

Framework documents published in 2018-23	
Frontline staff (before duplicates were removed 49; after 27)	49
KIND staff	30
Technical professionals in H&C	2
Academic articles	54
Other skills documents (assessment tools, news items, etc.)	54
Total frameworks	189

[4] *E.g., different sources picked up in the search referring to the same frameworks.*

IV - Analyses

The analysis of these data has been a sensemaking exercise, in which we have sliced and diced the data set in different ways to understand it better. The work has progressed through six distinct sets of analyses, each helping us to illustrate certain key observations of the frameworks.

Search Phase 1 analyses (57 frameworks after exclusions):

1. Chronological overview – tracing the emergence of frameworks over time.
2. Geographic origin of frameworks – mapping the geographic regions the frameworks are published in.

Search Phase 2 analyses (189 frameworks before categorisation):

3. Genealogical analysis of frameworks – which frameworks have influenced each other and how (16 frameworks).
4. Classifying frameworks according to target group – which broad professional categories are the frameworks aimed at - focus on frontline staff (189 frameworks reduced to 27).
5. Analysing the use of terminology: the meanings and use of digital skill, literacy, capability, or competency (27 frameworks).
6. Content analysis of the 27 frameworks aimed at frontline staff through nine case studies.

Analysis 1: Chronological overview

Organising the dataset chronologically helped us understand the rate of emergence of these frameworks. At this point, we had not yet delimited the analysis on looking at just the frontline staff, but considered all 57 frameworks listed in Appendix 1. The very first digital skills framework ever (that we could identify) was published by the American Nurses Association (ANA) for nursing informatics in 1995, entitled "***Nursing informatics: scope and standards of practice***". The framework was published following ANA's recognition of nursing informatics as a new area of nurse specialty in 1994 (ANA, 2008). Interestingly, this is not only the earliest identified framework, but it also targeted healthcare staff, illustrating the importance of digital upskilling for healthcare frontline staff since earlier days of implementing digital in healthcare settings.

Following this, from late 1990s to early 2000s, four world-renowned and still widely used digital skills frameworks targeting citizens were first created and published, including founding their parent organisations:

1. the European Computer Driving Licence (ECDL) (Council of European Professional Informatics Societies CEPIS, 1996)[5]
2. the International Computer Driving Licence (ICDL, 1999), derived from ECDL (ECDL and ICDL merged in 2019) (ICDL Asia 2015; ICDL Org 2023)
3. the International Society for Technology in Education (ISTE) Standards by ISTE in 1998 (ISTE 2017)
4. the Skills Framework for the Information Age (SFIA) 1; now SFIA version 8 (SFIA, 2021).

These organisations created digital skills standards/ competencies applicable in educational settings and for various work roles, reflecting the growing need for citizens to be digitally literate in today's increasingly digital world (Martin & Grudziecki, 2006). The organisations also offer training to both individuals and to organisations that provide employees with training opportunities.

From 2011 onwards, the number of digital skills frameworks started increasing. Many of these also have also been specified for healthcare context. In the first search round, we identified a total of 49 digital skills frameworks published around the globe since 2011; 14 of these were published between 2011-17, and a striking 36 frameworks since 2018 (all until 2022 inclusive[6]) (Figure 1 below).

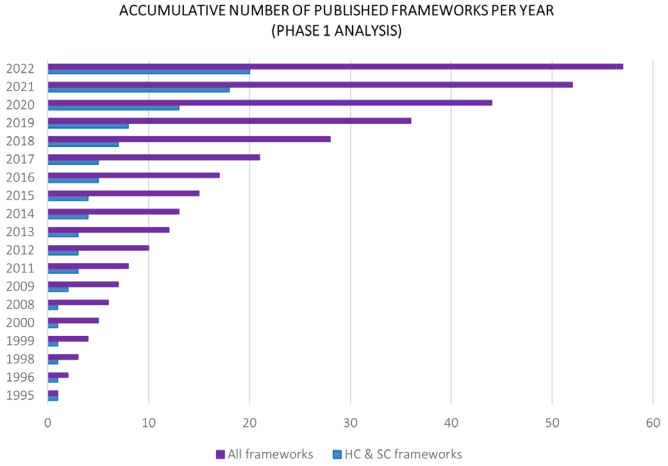


Figure 1. *Proliferation of frameworks over time, since the first one from 1995. This includes total numbers of published digital skills frameworks to-date for application in healthcare (HC) & social care (SC) and the total (including frameworks for citizens and general workforce).*

[5] *ECDL/IDCL have provided internationally renowned training opportunities for individuals and organisations, ICDL certification(s) (ICDL Europe, 2023). In Europe, ICDL (2021) have been extensively involved in European countries' digital skills training: e.g., informed France's National Register of Professional Qualifications (CPF); forms the official standard to use for computer skills evaluation across the Italian education system; used by Turkish Ministry of Education to inform their primary and secondary school curricula including the state exam the standard for digital literacy in Romania; and, mapped on the UK Qualification Framework by the Office of Qualifications and Examinations Regulations (Ofqual).*

[6] *Inclusive of the five 2022 frameworks we had found at that point of the phase 1 search. More 2022 frameworks were found in phase 2 search, however, due to focus on frontline healthcare frameworks in phase 2, we do not have the exact figure for the total of all types of frameworks from 2022 (e.g., citizen-facing ones or for healthcare informatics).*

The rapid proliferation in published frameworks can be related to a combination of government initiatives as drivers, and technological advancement as enablers in that period (Morrison et al., 2022). Between 2016 and 2018, various UK government initiatives called for investment into digital health due to increased pressures to address healthcare costs. For example, the ***UK Digital Strategy*** (2017) outlined the importance of the development of the digital infrastructure within public and third sector services to improve the UK economy, and to close the digital divide by addressing digital poverty issues. What is more, the strategy inferred that creating the digital infrastructure will create more high-skilled and high-paid jobs, and will help people to access more services, progress at work, and improve health and wellbeing. Public Health England (2017) published their digital strategy '***Digital-first public health***' with the aim to reduce health inequalities by improving healthcare services across the UK, as well as increasing citizen's capacity to access digitally enabled services. Furthermore, from 2016 to 2018 the rapid growth and expansion of healthcare IT infrastructures with growing patient data ('big data') has enabled the development of remote care provision and care personalisation (Gu et al., 2020). This is when artificial intelligence (AI), machine learning and digital solutions, including 5G enabled telehealth[7], mHealth[8], and the Internet of Things (IoT)[9] emerged within healthcare contexts (Morrison et al., 2022).

In that period, we saw updates being published for many of the older frameworks with just minor amendments that reflect changes in the use of language or in available technologies. This insight, and the growth in the number of published frameworks suggested we limited the second search only to the last five years (2018-23).

Analysis 2: Geographic origin of frameworks

In this analysis, we were keen to understand the geographic origin of the 57 frameworks identified in Phase 1. Majority of these frameworks have been published in the English-speaking world or in Europe,, with a specific spike in frameworks being released in the UK.

The search brought up eight European (8) frameworks, and eight international frameworks (8) mainly in collaboration between European and US organisations. Fewer frameworks were identified in Asia, Africa, and South America (Figure 2).

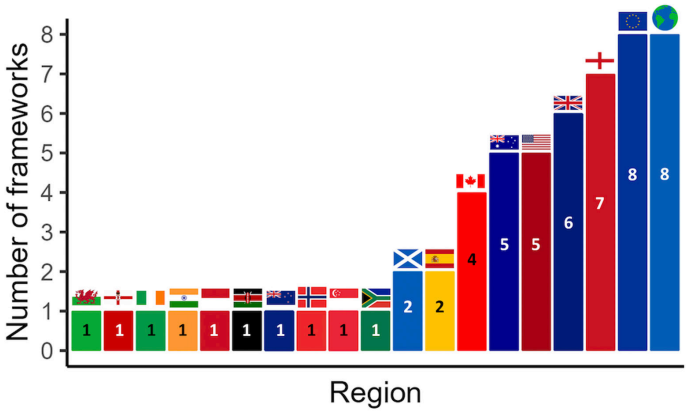


Figure 2. *Stage 1 Data - Distribution of digital skills frameworks across continents and countries/areas. Note. EU count represented by its flag (second from the right) includes ECDL (ICDL, 2021), founded by CEPIS to support European informatics education (European rather than EU category). CEPIS was supported by the EU, thus included in this count.*

United Kingdom

Out of the individual countries, the United Kingdom stands out with a total of 17 out of the 57 frameworks identified in Phase 1, all published between 2011-21. It must be noted that this finding might also reflect our search methodology, which focussed on English language sources only. Specifically, there were six frameworks applicable to all of UK, followed by seven for England, two for Scotland, and one framework each for Wales and Northern Ireland (see table in Appendix 1). Fourteen out of the 17 frameworks targeted health and care staff, including frontline staff[10] and specialist informatics workforce[11]; one was aimed at general population/workforce[12]; one was aimed at awarding bodies providing digital skills education in UK[13]; and, finally, one was aimed at adults who are in social care[14].

In 2015, Jisc published the ***Building digital capability*** framework aimed at digital leaders, staff in health and social care, and students in educational settings (Jisc 2015a; 2015b). The framework went on to influence the major frontline healthcare staff frameworks, such as the ***Health and Care Digital Capabilities Framework*** (NHS HEE, 2018) (more on this in the sections below) .

[7] *Care-related services supporting patient care via remote telecommunication technologies.*
[8] *Mobile communication devices used to deliver care services, e.g., wearables such as activity trackers, and monitoring and diagnostic remote services using mobile applications.*
[9] *A hardware network connecting and communicating to each other via the Internet.*
[10] *E.g., Core digital skills model in social care (Skills for Care, 2016).*
[11] *E.g., Core Competency Framework for Clinical Informaticians (FCI Competency Framework) (Faculty of Clinical Informatics, 2021)*
[12] *Namely, aimed at digital leaders, staff in health and social care, and students in educational settings in Building digital capability by Jisc (2015a, 2015b).*
[13] *National standards for essential digital skills by the UK Government (Department for Education, 2019).*
[14] *Digital Skills Framework (in partnership with the NHS Transformation Directorate) (Digital Social Care, 2022).*
[15] *Refers to NHS Health Education England.*

One of the well-known non-healthcare frameworks is the ***Digital, Data and Technology Profession Capability Framework (DDaT) (Central Digital and Data Office, 2017 (version 1))***. This indicates how working with data and digital was becoming central to various governmental organisations' operations from around 2017 onwards. The framework sets out skills needs for people working with digital, data and technology in governmental organisations, including employability opportunities and career pathways. The framework has subsequently been applied to the healthcare settings in England and Wales. The Scottish government and the Scottish Digital Academy have adapted the framework for use in the Scottish public sector (e.g., Scottish Government, n.d.), and work is currently under way to align this framework for specialist digital, data and technology workforce in healthcare settings also in Scotland.

Europe

For the remainder of Europe, we identified eight frameworks published by the European Union (EU). These were mainly published by the European Commission between 2008 to 2021 and were intended to provide a digital skills standard[16] to be applied across the EU countries. Initially, these frameworks targeted citizens[17], teachers[18], and various employers/employees[19] .

Out of the European frameworks, it is essential to highlight ***DigComp***, a citizen-facing framework first published by European Commission in 2013; its latest version, ***DigComp 2.2***, is from 2022 (Vuorikari et al., 2022b). This is one of the most comprehensive, extensively researched and developed digital competencies frameworks available globally, frequently updated to reflect the changes in digital technologies, legislation, and culture. Being available in 23 languages (EU Science Hub, 2016) across 27 countries (Misheva, 2021), it has a systematic library of associated documents and publications detailing the processes behind its creation and implementation, including case studies suggesting various ways the framework has been implemented on national levels across EU member states[20] (Vuorikari et al., 2022a; Vuorikari et al., 2022b).

The DigComp framework[21] has informed the design of other digital competency frameworks around the world, the design of digital competency assessment tools, training courses and materials, and assisted in identifying digital needs for various professions, including in health and care (Joint Research Centre EU et al., 2018). It has also contributed to several EU strategies[22].

Two other European partnership frameworks worth mentioning are:

1. EFT READY Model[23] for training/training providers and curriculum developers piloted in Israeli secondary schools between January and March 2022 was published by the European Training Foundation in 2022 (UNESCO, 2023). It is interesting as it encourages users to adapt the model to each organisation, including translating to local languages and the language-associated contexts to fit the users best.
2. EDISON Data Science Competence Framework (CF-DS) (EDSF) (Demchenko et al., 2017; Demchenko et al., 2019) was authored by EU partnership EDISON to establish data science as a separate profession and standardise the skills needed for various roles. Again, this highlighted how around 2017 data science and related professions had become focussed upon by various governing bodies and started to become standardised.

Moreover, Spain published two frameworks independently from the EU, by National Institute of Educational Technologies and Teacher Training (INTEF, 2017) for teacher education, and by Profuturo (Sáez et al., 2020), a partnership with professionals and organisations from Latin America, Caribbean, Africa, and Asia, targeting digital upskilling in these areas.

[16] *Many European countries have included international certifications such as ICDL into their national digital literacy curricula (e.g., Poland, Italy) and related employment digital needs (e.g., France, Ireland) (ICDL, 2021). For this reason, it is somewhat difficult to establish landscape across Europe, especially due to publications in various European languages, which are inaccessible due to a language barrier. For example, the French employment-focussed digital literacy training associated with ICDL and funded by the French government, is only known through the ICDL (2021) document. It is otherwise named 'the Compte Personnel de Formation (CPF)'.*

[17] *E.g., DigComp 1.0, European Commission (Institute for Prospective Technological Studies (Joint Research Centre, et al., 2013).*

[18] *E.g., 'SELFIE for Teachers' (European Commission, 2021)*

[19] *E.g., European Committee for Standardization (CEN), 2008 – framework for information professionals.*

[20] *These include complete and partial translations across EU countries (12 EU states), and national, regional, and sector specific adaptations (in four EU states) (Vuorikari et al., 2022a).*

[21] *All its versions.*

[22] *DigCom has contributed to, e.g., to the European Commission's focus 'A Europe fit for the Digital Age' and 'Next Generation EU' – the EU's recovery plan (EU Science Hub, 2023); EU's Digital Education Action Plan 2021-2027 (European Commission, 2020).*

[23] *Full name is 'Reference model for Educators' Activities and Development in the 21st century'.*

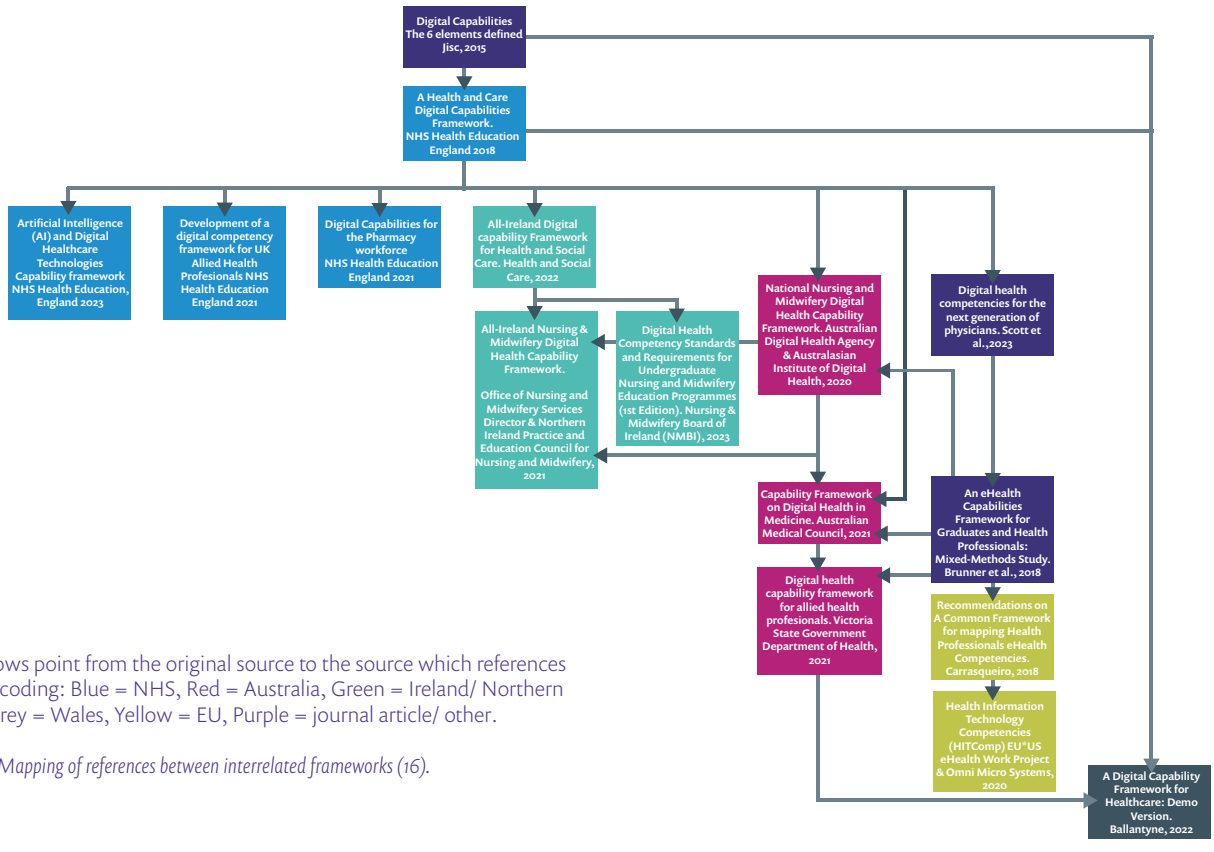
International partnerships

The eight international digital skills frameworks identified provide digital skills standard training for individuals and organisations.

1. In 1998, the International Society for Technology in Education (ISTE) (ISTE, 2023) published their well-known and still relevant ***ISTE Standards*** for use of technology in teaching and learning for students, teachers, and administrators.
2. International Computer Driving Licence (ICDL), version 5 published in 2022 (ICDL, 2022).
3. Skills for Information Age (SFIA), version 8 published in 2022 (SFIA, 2023).
4. UNESCO digital skills framework for policy makers, researchers, and teachers/trainers (Law et al., 2018).
5. DQ Institute's ***DQ Framework*** (Global Standards for Digital Literacy, Skills, and Readiness, IEEE 3527.1 Standard for Digital Intelligence (DQ)) (Park, 2019) is a framework setting global standards for 'digital intelligence' focusing on citizen empowerment.
6. Microsoft (2022) framework for citizen digital literacy; and
7. Technology Informatics Guiding Educational Reform (TIGER) from 2019, a nurse informatics framework based on international standards (mainly Europe and USA) for emerging nursing informatics roles, published by the Informatics Competencies Collaborative (TICC) and applicable to both European and US contexts (Hübner et al., 2019); and
8. ***Health Information Technology Competencies*** (HITComp) framework (EU*US eHealth Work Project & Omni Micro Systems, 2020) provides a systematic matrix of competencies in digital health applicable to both the EU and USA contexts, tying together concepts of skills, competency, education, and capability. It stands out among the globally reaching frameworks in that it was created by a working group consisting of private and public sector industry professionals across digital health and education in 2010 in collaboration between the European Commission and the US government.

Analysis 3: Genealogical mapping of frameworks

Organising the frameworks chronologically and analysing their geographic origins and content, we discovered that many of the frameworks cross-referenced each other. Moving into Phase 2, we set out to analyse the data by looking at the contents and inter-framework references to understand how the different frameworks had influenced each other. This analysis helped us to create a genealogical mapping of 16 related frameworks/documents (see Figures 3 and 4; listed in Appendix 2). From this analysis onwards, we focussed on frameworks published since 2018.



Note: arrows point from the original source to the source which references it. Colour coding: Blue = NHS, Red = Australia, Green = Ireland/ Northern Ireland, Grey = Wales, Yellow = EU, Purple = journal article/ other.

Figure 3.*Mapping of references between interrelated frameworks (16).*

The mapping exercise pointed to Jisc (2015a, 2015b) ***Digital Capabilities framework*** as the foundational framework used in healthcare related frameworks today. The Jisc framework was based on a combination of an existing Jisc framework (Jisc 2014) and an extensive review of over 60 skills frameworks across international, national, and local levels. This review was primarily focused on frameworks relevant to education, but included several widely used generic frameworks, e.g., the recent DigComp (Institute for Prospective Technological Studies, 2013).

The Jisc (2015a, 2015b) framework includes six domains: 1) ICT proficiency; 2) Information, data, and media literacies; 3) Digital creation, innovation, and scholarship; 4) Communication, collaboration, and participation; 5) Digital learning and development; and 6) Digital identity and wellbeing.

The Jisc (2015a, 2015b) framework was key in influencing the NHS HEE's (2018[24]) ***A Health and Care Digital Capabilities Framework***. The NHS framework uses the same six core domains as the Jisc framework, with some changes to wording and scope. To adapt the Jisc model for use in a health and care settings, Safety and Security were added alongside identity and Wellbeing; Teaching was added to the Learning and Development domain; and Scholarship was substituted with Research. Of these changes, the addition of Safety and Security is the only truly novel addition. The framework also added approximately 30 more specific capability statements, each assigned to skills levels (1-4)linked to each of the six domains.

The NHS HEE (2018) framework subsequently influenced the following frameworks:

- ***National digital health capability framework for nurses and midwives (Australian Digital Health Agency, 2020), Capability Framework in Digital Health in Medicine (Australian Medical Council Ltd, 2021),***
- ***All-Ireland Nursing & Midwifery Digital Health Capability Framework (Office of Nursing and Midwifery Services Director et al., 2021)***
- ***All-Ireland Digital Capability Framework for Health and Social Care (Health and Social care, 2022) – identical to one above.***
- ***A Digital Capability Framework for Healthcare Wales (Health Education and Improvement Wales, 2022).***

Of the frameworks listed above, the ***Australian National digital health capability*** framework for nurses and midwives (Australian Digital Health Agency, 2020) is particularly central. This framework presented one of the substantial revisions of the NHS (2018) framework, organising it into a five-domain structure instead of six (while still maintaining the same core capabilities). This model was later continued in the abovementioned successive Australian frameworks, and adopted for use in frameworks from Ireland and Northern Ireland (Figures 4 and 5). It is also informing the development of a framework for the medical staff in Australia (Australian Medical Council Ltd, 2021), as well as Nursing Education Curriculum in Ireland (NMBI, 2023).

EU work is lacking in references linking it to digital health skills work across the aforementioned countries (UK, Ireland, and Australia). However, the Jisc (2015a, 2015b) framework references the European Union DigComp (Institute for Prospective Technological Studies, 2013) framework among those that it reviewed.

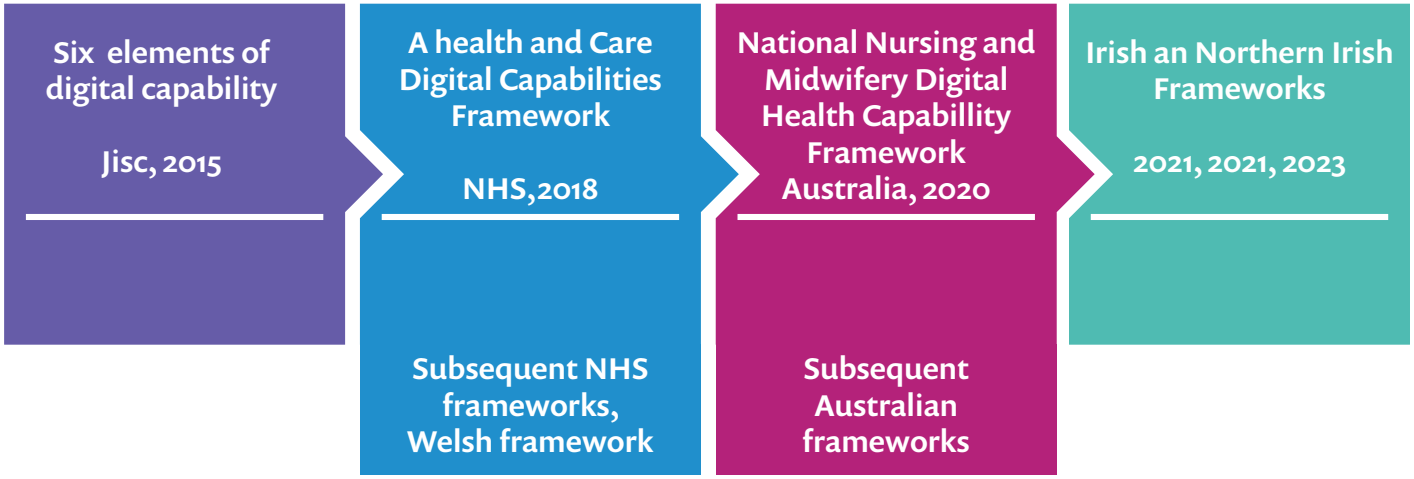


Figure 4. *Summary of framework development and progression over time among interrelated frameworks from Figure 3 (16).*

[24] *There are other NHS frameworks, which may have also been influenced by the Jisc 2015 study, but these were not included in this analysis.*

Analysis 4: Classifying frameworks according to target audience

In the 4th analysis, we looked at all 189 frameworks identified in the second search, and categorised these according to their target audience. This helped us focus the analysis on those whose digital working requires most support.

The DHI divides the people working in digitally enabled health and care into three broad categories of staff (Rimpiläinen, 2022; Morrison et al., 2022):

- Frontline healthcare staff
  - Anyone involved in the day-to-day delivery of care.
  - Staff requiring managerial level understanding of digital health systems and staff who require some specialist "KIND" capability.
- Specialist knowledge, information, digital and data (KIND) staff working in health and care; and
- The technical staff (those who design, develop, deliver, implement, service and secure digital solutions for use by health and care services). (Figure 5).

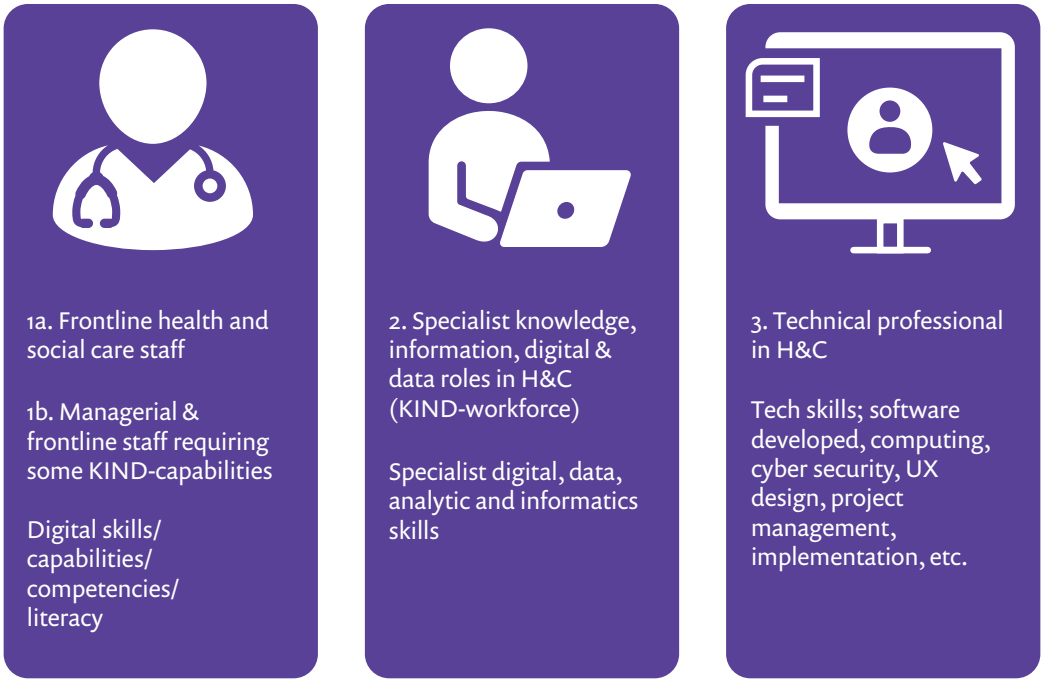


Figure 5. *The three broad categories of staff in digitally enabled healthcare workforce.*

Another way to depict the requirements for digital proficiency by the different staff groups are these two triangles below, whereby the base-layers refer to basic digital literacy required of all citizens to be able to engage with a digitally enabled healthcare (and other) systems, with the depth and breadth of digital proficiency increasing while the professions become more and more specialised in digital / data / technical roles. When cataloguing the frameworks and analysing their historic evolution, we applied the categorisation from Rimpilainen et al.'s (2018) report (Figure 6).

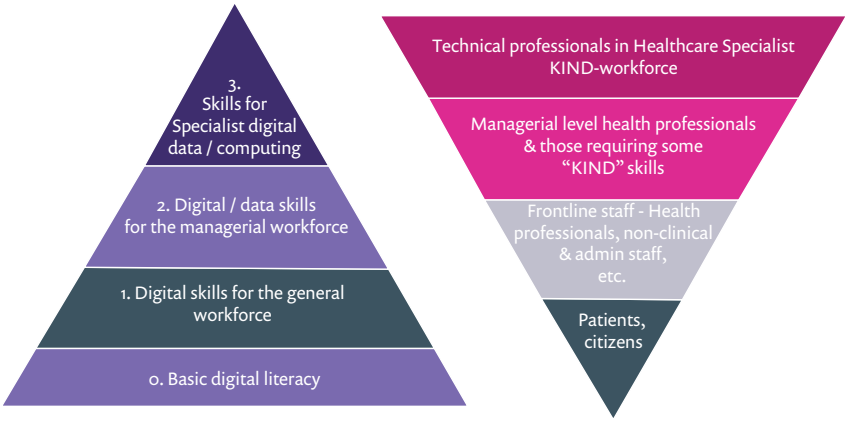


Figure 6. *Triangles depicting levels of digital proficiency required by different professional categories. (Rimpilainen et al., 2018)*

Hence, in this report we will focus on frameworks (27)[25] aimed at the frontline healthcare staff: doctors, nurses, psychologists, pharmacists, allied health professionals, administrators, etc. The rationale is that the specialist KIND staff, and the technical staff working in health and care require higher level digital capability / competency to do their jobs to begin with; hence 'learning digital skills' does not really concern them. The required digital competency to succeed in specialist KIND or technical roles is both broader, deeper, and more specific (cf., Rimpiläinen et al., 2019; DHI 2019).

The 27 frameworks are listed in Appendix 3.

Analysis 5: Use of terminology

Common terminology in frameworks used to support digital working include ***skill, literacy, competency, and capability***. Unfortunately, there remains considerable disagreement about how these terms should be defined in digital healthcare (Anastasiou & Smith, 2023, Martin & Grudziecki, 2006). The terms are being used often interchangeably and inconsistently between sources, which can lead to confusion around the precise intention or scope of the framework. In this analysis (Analysis 5), we will seek to clearly define these terms to facilitate a shared understanding in discussing the topic.

To analyse the language used in frameworks, we first categorized the 27 frontline frameworks according to the terminology used in their titles (table 2):

Table 2. *Frameworks categorised according to terminology used.*

Term	No of frameworks
Digital capability	8
Digital competency	5 + 13 (the 13 are adaptations of the same framework)
Digital literacy	1
Digital skills	0
Total	**27 (14 + 13)**

While 'digital skills' is the most common way to refer to this topic in everyday parlance, no framework had 'digital skills' in the title. In the competency category, one framework turned out to be the basis for additional 13 digital competency sub-frameworks for different professions[26]. Hence, we only analysed the main one, but included the 13 others to highlight a point about the nature of competency frameworks.

Next, we examined in detail how each framework defines digital skill / capability / competency and literacy. The definitions, with examples of what they were referring to (e.g., digital competency or digital skill), were put into a matrix for easier comparison. We also went back to the Cambridge Dictionary[27] definitions of the four terms to compare those with how the frameworks defined and used them.

Furthermore, we then went back to the frameworks to compare their content and the terminology used to analyse whether they used that 'appropriately', i.e., in relation to the examples of skills / competencies / capabilities that were given in the frameworks.

Definitions

Digital Literacy

There are two main approaches taken in defining digital literacy: some define it in line with the traditional definition of literacy, as the 'basic ability to use digital technology' (cf. 'basic ability to read and write in Cambridge English Dictionary), while others define literacy as a broader, multifaceted concept (e.g., Jisc, 2014; Huvila, 2012). Loewus (2016) suggests that adding 'digital' in front of 'literacy' can make the term encompass much more. Hence, definitions of digital literacy can vary, ranging from foundational abilities to a more complex, aspiring model, like the way this report uses 'capability'.

Both older and the more recent definitions of digital literacy include the idea of being able to understand and use digital information and technology to function effectively within society (Gilster, 1997, Lennon et al., 2003, NHS HEE, 2018). This report will define digital literacy as 'the ability to use and understand digital technology and information to effectively participate in society'. In other words, digital literacy describes the fundamental digital ability, which underpins the development of more complex and profession-specific skills.[28]

[25] *After removing duplicates from the 49 frameworks indicated in Table 1.*
[26] *Development of a digital competency framework for UK Allied Health Professionals—2020 Topol Digital Health Fellowship and 13 profession-specific competency frameworks for Allied Health Professionals (AHPs) (NHS Health Education England, 2020).*
[27] *https://dictionary.cambridge.org/dictionary/english/literacy*
[28] *It is important to note that this may differ from how digital literacy is conceptualised across the included frameworks. Oftentimes, digital literacy was depicted as encompassing the total ability to meet the desired digital capabilities (e.g., NHS HEE, 2020).*

Digital skills

The most common term employed in the frameworks supporting digital working is 'digital skill', often used as shorthand to refer to what could better be termed 'competency' or 'capability' in these contexts. Being a more colloquial term, 'skill' is not often defined in academic literature. The Cambridge English Dictionary simply describes[29] it as "an ability to do an activity or job well, especially because you have practised it". The Official Journal of the European Union (2018) defines it as "the ability and capacity to carry out processes and use the existing knowledge to achieve results". In this document, we define digital skill simply as 'the ability to carry out a task or a process digitally / in a digital context'.

Digital Capability vs Digital Competency

There is a substantial history of debate around how 'competency' should be defined when developing frameworks and standards (Hager & Beckett, 1995). A key part of the definition of competency is to be able to sufficiently perform a given task or role. In the EU, digital competency has been defined, e.g., as "having sufficient skills and capability to be efficient with digital processes and devices" (Ala-Mutka, 2011, 16), or "the confident, critical and responsible use of, and engagement with, digital technologies for learning, at work, and for participation in society" (Official Journal of the European Union[30], 2018; Vuorikari et al., 2022b, 3). Also, key to the EU definitions is that competency involves a combination of knowledge, skills, and attitudes (Official Journal of the European Union, 2018).

However, there are other important considerations regarding how competency and capability are defined - and differ- here specifically in a healthcare context. In a 2017 document on digital literacy, the NHS HEE described digital competency as: "usually focused on what a professional is able to do. Competencies describe current practices in known roles." By contrast, "Capabilities describe new, and emerging challenges. They prepare us for these rather than our ability to meet existing ones." (Health Education England & Royal College of Nursing, 2017, 14)

Brunner et al. (2018, 2) explains that while capability is often described as similar to competency, capability "in fact encompasses competence and extends beyond the technical skills implied by competence to emphasize the components of adaptability to change, lifelong learning, and self-efficacy." They suggest that for that reason, capability informed frameworks "address wider aspects of professionalism, focussing on supporting continuous development rather than assessment of a skill at a specific point in time." Prior academic literature makes a similar distinction. Cairns (2000) defines competency as "individual and measurable skills demonstrated and assessed against agreed standards of competence", while capability is "an all-round human quality, an integration of knowledge, skills and personal qualities used effectively and appropriately in response to varied, familiar and unfamiliar circumstances".

The Official Journal of the European Union (2018) and Cairns (2000) suggest that both capability and competency involve a combination of knowledge, skills, and attitudes. Each of these sources has in common the notion that competencies are specific, measurable, and grounded in a given situation or role, while capabilities are more generic, future-oriented or flexible and can be applied to variable circumstances.

This is in line with previous DHI work (Rimpiläinen et al, 2019), which has recognised that competencies relate to current practices in known roles, while capabilities describe the ability to meet new and emerging challenges. In short, competency demonstrate what a person already knows and can do; capability demonstrates a person's ability to learn something new.

With this distinction in mind, we analysed the different frameworks, dividing them either into digital competency or digital capability ones based on their ***content***.

[29] https://dictionary.cambridge.org/dictionary/english/skill?q=skills

[30] Council Recommendation of 22 May 2018 on key competences for lifelong learning (Text with EEA relevance.), ST/9009/2018/INIT, EUR LEX (2022). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.C_.2018.189.01.0001.01.ENG&toc=OJ%3AC%3A2018%3A189%3ATOC

In sum:

- Digital literacy is a foundational ability prerequisite to developing digital skills (e.g., being able to locate and open your email programme), OR it can be used as an umbrella term to denote the wider ability to do one's work in a digital context.
- A digital skill is the ability to perform a digital task (e.g., being able to send an email).
- Digital competency is the ability to perform a given digital task to an agreed job specific standard (e.g., being able to send an email that meets the organisational standards for your job role).
- A digital capability is the ability to use transferable skills to learn to perform a future, yet to be defined digital task (e.g., being able to use digital means to communicate with your colleagues or your patients).

Analysis 6: Content analyses of the frameworks

In the final set of analyses, we carried out a content analysis of the 27 frameworks covering 'skills' requirements for frontline staff (listed in Appendix 3). In this final section, we exemplify each of the earlier points made in more detail, discussing the evolution and inter-relatedness of frameworks, how the digital maturity of the health and care infrastructure and that of the workforce is reflected in the frameworks; the importance of being clear about the terminology used to describe the content and purpose of the frameworks, and how these impact expectations laid upon the frameworks; the different culture or traditions underlying the framework development, and more.

This section presents short case studies of clusters of frameworks for ease of comparison to highlight certain observations. Case studies 6.1-6.4 cover the different capability frameworks identified for analysis; Case studies 6.5-6.9 cover the competency and the one digital literacy framework.

Case study 6.1: The NHS tradition of digital literacy frameworks

The seminal ***A Health and Care Digital Capabilities Framework***, published in 2018[31] by NHS Health Education England, set the scene for digital to take central place in healthcare staff training and professional development. The framework is an adaptation of the Jisc (2015a, 2015b) ***Building digital capability framework***, whose starting point is person-centred digital literacy, defined as "those capabilities that fit someone for living, learning, working, participating and thriving in a digital society".

The purpose of the framework was to support the improvement of the digital capabilities of ***"everyone working in health and care"***. The tool was intended to be dynamic and developmental, offering guidance on how to extend staff and individual digital capabilities to deliver better care in a complex, ever-changing world. Crucially, the framework promotes positive attitudes towards change, technologies and innovation.

The framework divides ***digital literacy*** into six domains of ***capability***, each made up of skills, behaviours and attitudes: 1. Communication, collaboration and participation; 2. Teaching, learning and self-development; 3. Information, data and content literacies; 4. Creation, innovation and research; 5. Technical proficiency, and 6. underpinning all others, Digital identity, wellbeing, safety and security (Figure 7).

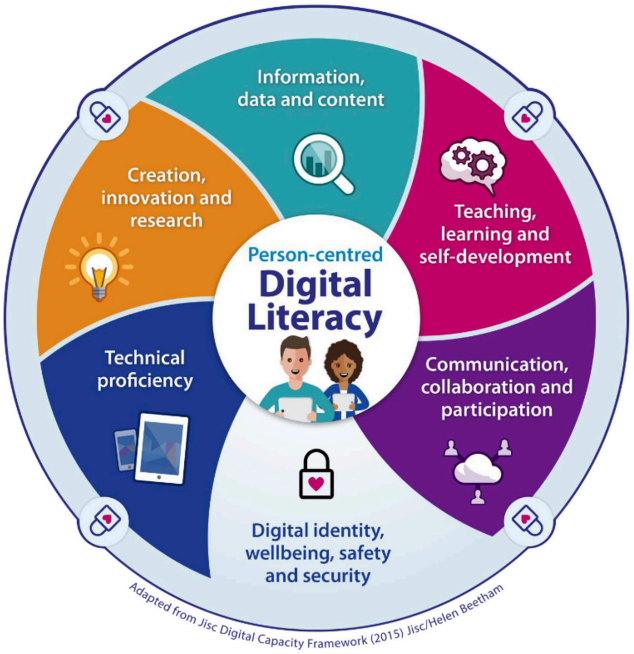


Figure 7. *The six digital capability domains in NHS HEE (2018) framework.*

[31] *During the write up of this study, this framework has since been removed from the NHS website, presumably to give space to more recent (NHS HEE, 2023a) framework.*

Each domain is described in a series of capability statements, which are further presented across four levels of proficiency ('I know'; 'I can'; 'I am confident'; 'I am an expert').

This framework has been the basis or inspiration for various other profession and service-specific NHS frameworks. For example, ***Digital Capabilities for the Pharmacy Workforce***, published by NHS Health Education England (2021n), is based on this framework. Here, the six capabilities are presented in a matrix-format aligned to seven pharmacy profession roles (e.g., Pharmacy Support Staff, Advanced Pharmacy Technician), which are mapped against the digital skills proficiency levels required for each professional role. The second matrix lists the different capability statements and matches these against available training resources. In this way, the pharmacy capability framework in fact resembles a competency framework, similarly to the NHS Health Education England's (2021) digital competency framework for Allied Health Professionals (AHPs) (see Case 6.3).

The influence can also be seen in a recent UK framework by Health Education and Improvement Wales (2022), ***Digital capability framework for healthcare in Wales- pilot***. The Welsh framework was piloted until 31st March 2023, inviting healthcare workforce to take part in the online resource, which is to be used for self-assessment and/or management-led assessment of learning needs to inform training and education opportunities in digital health skills. The framework was developed by a healthcare professionals' working group depicting skills, behaviours and attitudes grouped into domains and sub-domains, reflecting capabilities across three levels showing increasing ability. Like the NHS HEE 2018 UK framework, the framework is divided into six domains: 1) Using Technology, 2) Understanding Informatics, 3) Research & Innovation, 4) Safety & Wellbeing, 5) Working with Others, 6) Learning & Leadership (see Figure 8).

Figure 8. *The six capability domains in the Health Education and Improvement Wales (2022) framework.*

How the domains relate to the 2018 UK framework is depicted in Table 3 below.

Table 3. *Domain names comparison between healthcare workforce frameworks by Health Education and Improvement Wales (2023) and NHS HEE (2018).*

Framework	Corresponding Domains					
Health Education and Improvement Wales (2022)	Using Technology	Understanding Informatics	Research & Innovation	Safety & Wellbeing	Working with Others	Learning & Leadership
NHS HEE (2018).	Technical Proficiency	Information, data, and content	Creation, Innovation, and Research	Digital Identity, Wellbeing, Safety and Security	Communication, Collaboration, and Participation	Teaching, Learning, and Self-development

Despite the similarity with the NHS HEE 2018 framework, the Welsh framework is also influenced by the Australian nursing and midwifery capabilities framework (2020)[32] discussed more in Case 6.2. The similarities are reflected in capability descriptions and domains (e.g., both referring to digital professionalism, originally having emerged in the Australian framework). However, the Australian framework has just five domains, with larger focus on healthcare informatics and digital health transformation as opposed to individual healthcare professional-centred development. Thus, with this capability framework, Wales combines the two traditions by retaining the person-centred development approach while bringing in the digital health transformation into focus.

Case study 6.2: Australian-Irish capabilities encompass competency

National Nursing and Midwifery Digital Health Capability Framework (Australian Digital Health Agency, 2020) is a highly influential digital capability framework intended for nursing and midwifery practice in Australia. Created by the Australian Digital Health Agency & Australasian Institute of Digital Health, its purpose is to "define the digital health knowledge, skills and attitudes required for professional practice; complement existing individual knowledge, skill, and attitudinal frameworks; and provide a solid basis for tailored learning".

The frameworks use Brunner et al.'s (2018, 2-3) definition of capability, which encompasses competency: ***"Although capability has been described as being similar to competence, it in fact encompasses competence and extends beyond the technical skills implied by competence to emphasize the components of adaptability to change, lifelong learning, and self-efficacy. As such, capability informed frameworks address wider aspects of professionalism, focusing on supporting continuous development rather than assessment of a skill at a specific point in time".***

[32] *Australian Digital Health Agency, 2020*

The original Australian framework was developed by a broad team of stakeholders. The initial domains were informed by an extensive literature review, which also included the NHS HEE (2018) ***A Health and Care Digital Capabilities Framework***, various nursing standards, and Brunner et al.'s study (2018).

The final five-domain structure was arrived at through consultation processes with nurses, midwives, educational experts, and midwifery organisations. This change in domains reflects the differences in how digital health is conceptualised in Australia vs in the UK (Figure 9).

Figure 9. *The five digital capability domains in the Australian Digital Health Agency (2020) framework.*

The five domains are: 1) Digital Professionalism; 2) Leadership and Advocacy; 3) Data and Information Quality; 4) Information Enabled Care; and 5) Technology. The domains are related to nursing and midwifery professional standards (which relate to 'capability' being understood as encompassing 'competency') to make them more usable and relevant in professional development. Each domain is described with capability statements across three levels (formative, intermediate, proficient) associated with increasing ability. The framework is intended to help the practitioners and managers identify learning needs, and thus provide education opportunities with a great focus on increasing use of digital at work, and thus placing the digital health transformation at the centre of this framework.

This framework is currently being adapted for use by medical staff in Australia (Australian Medical Council Ltd, 2021).

In 2021, the Australian framework was adopted and adapted for use in Ireland following a local consultation, and published as A***ll-Ireland Nursing and Midwifery Digital Health Capability Framework*** (2021). The key goal of the initiative was to build a digital nursing workplace, and deliver a ten-year programme for digital transformation of Northern Irish Health and Social Care (HSC) services. Following the success of this initiative, the framework went through another series of consultations, before being published, almost word-by-word, as ***All-Ireland Digital Capability Framework by Health and Social Care*** (2022) aimed at the general health and social workforce in Ireland and Northern Ireland .One of the aims of the framework was to empower the workforce, as well as help identify learning needs. Both adaptations retained the same underpinnings and aims as the Australian framework, as well as the same five-domain structure with the same capability statements and levels of capability (Figure 10).

Figure 10. *The five domains and 15 sub-domains of the All-Ireland digital capability frameworks (Nursing and Midwifery - 2021 + Health and Social Care - 2022)*

The latest Irish adaptation of the framework is by the Nursing and Midwifery Board of Ireland (2023), who have adapted the framework as ***Digital Health Competency Standards and Requirements for Undergraduate Nursing and Midwifery Education Programmes*** (First Edition, 2023).

[33] *By the Office of Nursing and Midwifery Services Director together with the Northern Ireland Practice and Education Council for Nursing and Midwifery as a part of the Republic of Ireland's A Digital Roadmap for Nursing and Midwifery 2019 (NMBI 2021).*
[34] *It was published upon the joint effort by Republic of Ireland's 10-year plan to transform health and social care services with a highly developed digital health infrastructure, and Northern Ireland's Digital Strategy and Vision 2022-2030 outlining a digital health transformation journey (Health and Social Care 2022).*

This adaptation[35] changed the language from capability to competency, referred to the capabilities as capability standards, and removed the definitions of capability vs competency as per Brunner et al. (2018) used in previous related frameworks. However, the five-domain capability statement and levels' structure were retained verbatim. The stated rationale was that this document guides education reform as a standard. This is also why we have not accounted for this adaptation as a 'framework', even if it is included in this case study. Our interpretation is that this document refers to 'competencies' due to the professional nursing language, where 'competency' is related to standards, and that the distinction between competency and capability was not taken into consideration when creating this framework. As such, this serves as an example of how the confusion surrounding use of terminology may arise in this field.

Case study 6.3: Allied Health Professionals - Australian capability and UK competency frameworks.

Digital health capability framework for allied health professionals is another framework from Australia, published by Victoria State Department of Health in 2021. The framework has been developed as part of the digital health transformation in Australia, aiming to increase digital maturity in public health services and thus improve safety and care quality. In addition to surveying 164 AHPs, available literature and existing frameworks were analysed to guide the development of this framework. It links up with the Australian Digital Health Agency (2020) Nursing and Midwifery framework described above, the Brunner et al. (2018) definition of capability as encompassing competency, as well as the NHS HEE (2018) framework.

The framework, created in collaboration with various key stakeholders in Allied Health Professionals (AHP[36]) domain, outlines knowledge, skills and behavioural attributes needed by AHPs for best care practice. Furthermore, the framework provides a pathway for AHPs to direct their careers to digital health and clinical informatics, pointing to higher maturity in digital health job roles and the clinical informatics field in Australia compared to many other countries included in this review.

The four main domains outlined in the framework are: 1) The digital workplace (safe and effective allied health practice with use of digital); 2) Digital professionalism (allied health practice requirements in a digital work environment); 3) Data and informatics (aspects of data collection and application in allied health practice); and 4) Digital transformation (practice with use of technology) (Figure 11).

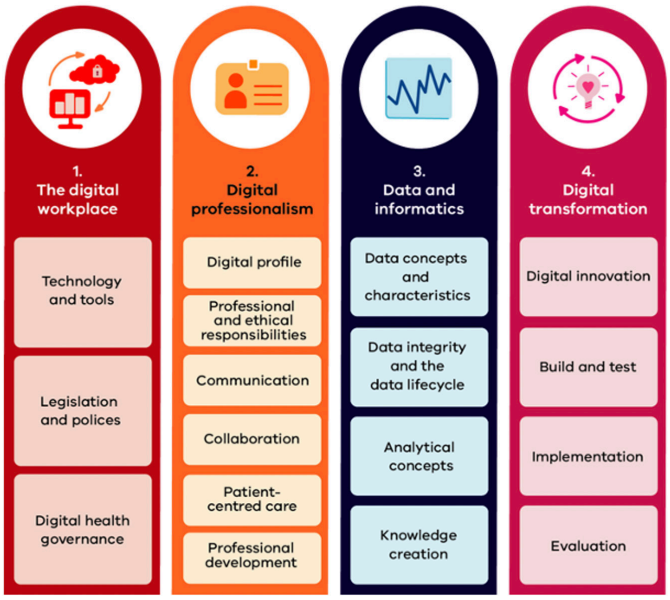


Figure 11. *The four capability domains and 17 sub-domains in the Victoria state Department of Health (2021) AHP digital capability framework.*

These are further divided into 17 sub-domains, where each is associated with capabilities, totalling 44 capabilities within the framework.

The framework suggests that capability development requires "a combination of growing knowledge and the ability to demonstrate associated behaviours". These capabilities were presented across four levels of capability: foundation, consolidation, expert and leader. The levels are also associated with the Allied Health professional career pathway blueprint (Department of Health and Human Services, 2019). Thus, this framework is interwoven with other professional guides ensuring its usability and relevance to the professionals.

The Australian framework is similar to ***the Digital Competency Framework for UK Allied Health Professionals***[37] (NHS HEE, 2021) in terms of professional areas it covers (e.g., professionalism, working with data).

[35] *The framework was excluded from the main analysis as it is meant to be applied in creating undergraduate nursing education and was translated into competencies but retained the same 'capability' framework structure.*
[36] *Twenty-seven (27) professions in Victoria (https://www.health.vic.gov.au/allied-health-workforce/allied-health-professions).*
[37] *The UK AHPs includes 14 professions; the Victoria state have 27 AHP professions.*

However, the capability statements are much more detailed in the UK framework due to it being labelled as a 'competency framework' and associated with specific professions (see Table 4 below).

Table 4. *Domain names comparison between healthcare workforce frameworks by Health Education and Improvement Wales (2023) and NHS HEE (2018).*

Australia AHPs ***capability*** framework	UK AHPs ***competency*** framework
Use data to inform best practice.	I have the ability to evaluate my own local departmental/ service level environment for best practice of clinical informatics towards optimum patient care (namely for data collection, sharing, interoperability and risk management).

The UK AHPs framework describes more specific competencies for AHPs practice, having been jointly published by NHS Health Education England and NHS England in 2021 to support the development of digital literacies[38] among the workforces.

A working group of 40 AHPs across all 14 allied health professions[39] (e.g., art therapists, paramedics) inferred the types of competencies their professional roles require in relation to use of digital technologies as part of professional practice. The working group produced profession-specific competency frameworks with 124 competencies across 10 domains (Figure 12), with profession-specific banding (band 3 to band 9 in the NHS). Categorising competencies as either 'unrequired', 'voluntary', or 'compulsory', the framework is adapted separately for use by each of the 14 roles[40] (NHS HEE 2021a-m), informing and enabling training and education opportunities. Despite the provided example above showing the higher-level detail of the UK framework's 'capability statements' describing competencies (compared to the Australian AHPs capability framework[41]), these were still suggested as not being sufficiently detailed and specific to be useful to the said professionals. An evaluation study of the AHPs Competence Framework carried out by Lee et al. (2023a) discovered that AHPs across the 14 professions found the framework competencies "too general" for these to be very relevant or helpful to their job roles. Examining this issue further, we discovered that the starting point for the development of the competency framework was a set of capability statements, which are more generic and future-oriented in nature than job-role specific competencies. The issue regarding the correct use of terminology discussed in earlier chapters is exemplified by this framework.

Both the Australian and the UK AHPs frameworks are presented as a self-assessment tool for AHPs to inform their professional development, a tool for managers and employers to organise training provision according to need, a guide for educators to develop training opportunities, and a guide for university education providers to develop curriculum. Taking everything together, it could be suggested that these statements linked to AHP competency areas provide a good starting point, but may need to be translated to more specific job-related standards for each profession to be viewed as actual observable, actionable, digital competencies. Both the inconsistent language use, and various levels of specificity when describing competencies for such a range of allied healthcare professions have made it difficult to define more precisely what knowledge, behaviours and digital technology use is required in healthcare roles.

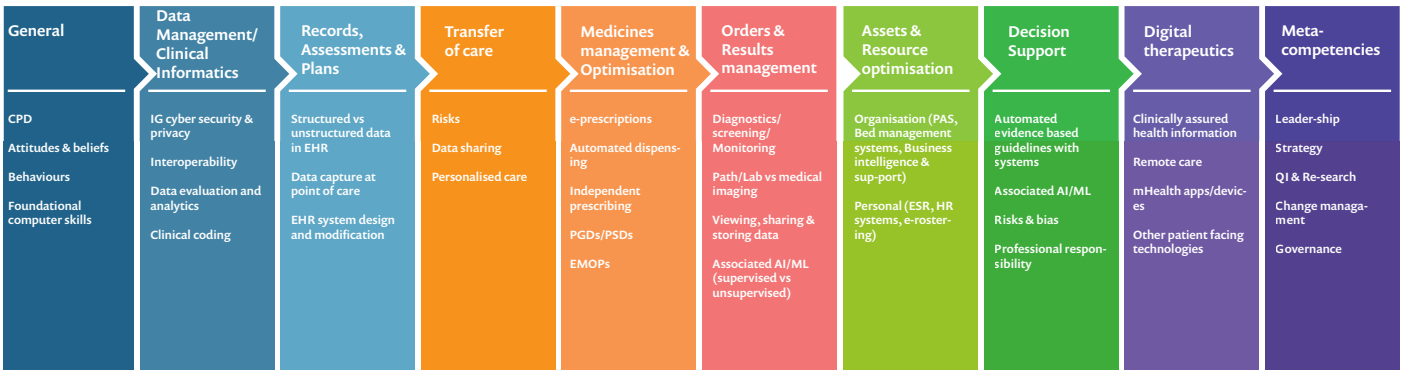


Figure 12. *UK Allied Health Professionals digital competency framework 10 domains (NHS Health Education England, 2021).*

[38] *Digital literacy here refers profession-specific literacy, not basic literacy to engage with digital technology.*
[39] *List of the 14 AHPs available here: https://www.england.nhs.uk/ahp/role/*
[40] *The main UK AHP framework has been adapted for each of the 14 Allied Health Professions, but with art and drama therapists' frame-works merged into one. These are the +13 competency frameworks listed in our data.*
[41] *Department of Health, State of Victoria (2021).*

Case Study 6.4: NHS AI and Digital Healthcare Technologies Capability Framework

In 2023, Health Education England commissioned University of Manchester to conduct research and digital skills learning needs assessment for healthcare staff to meet the emerging digital literacy needs arising from the uptake of Artificial Intelligence and other upcoming digital technologies (e.g., Machine Learning, Natural Language Processing, Internet of Things) (Health Education England et al., 2023, February 21). This is the most recent framework produced by the NHS to support working in a digitally enabled environment, and it assumes "basic level of digital literacy". Hence, building upon the NHS HEE 2018 *Health & Care Digital Capabilities framework*, the 2023 framework signals the advancement of technologies in use in health and care, and with that the changing nature of job roles required to support digital transformation of the sectors.

Like its 2018 predecessor, the framework is divided into six main domains with four associated knowledge levels. After this, the frameworks diverge. The 2023 framework presents novel domain classifications and newly emerged terminology. The six primary domains host additional 11 sub-domains with 195 individual capability statements. Each capability statement is associated with an "archetype" labelled as either Shaper, Driver, Creator, Embedder, or User. The archetypes are intended to help individuals identify which capabilities best apply to their role and duties, which are becoming "increasingly fluid" in the digitally transforming health and care sector. (Health Education England et al., 2023). The framework is presented as an interactive online resource with no visual depictions of domains to share.

The domains are: (1) Digital implementation; (2) Digital health for patients and the public; (3) Ethical, legal and regulatory considerations; (4) Human factors; (5) Health data management; (6) Artificial Intelligence.

Out of the five archetypes, "Users" in this framework applies to frontline healthcare staff. The relevance of the different domains per archetype varies. The most important domain for Users (covering knowledge levels 1-4 in each subdomain) is Domain 2 – Digital health for patients and the public. This aligns with the 2018 Domain 5, Technical proficiency, which is here articulated specifically as part of delivering patient care. The only other shared domain between the frameworks is Health Data Management (Domain 5, 2023; Domain 3 in 2018 - Information, Data and Content), where the 2023 framework articulates data skills to be understood on the healthcare systems level. Cyber security and data privacy and confidentiality make an appearance for the first time.

The other domains are new, bringing in Digital implementation; Change management; Ethical, legal and regulatory considerations; Leadership and management as part of Human Factors; and Artificial intelligence and associated technologies. In this framework, 'Digital Health Transformation' emerges for the first time, integrating already seen capability aspects in previous frameworks on a more mature level across different domains.

Finally, Health Education England et al., (2023) state that the framework can be used for self-assessment or management-led assessment of healthcare professionals' learning needs, and to help develop educational resources in higher education and healthcare services. The framework is being further developed into the Digital Artificial Intelligence and Robotics Technologies-Education (DART-Ed) programme to help understand educational requirements for AI learning. Furthermore, the Royal College of Surgeons and the Robotic and Digital Surgery (RADAR) initiative is working on assessing education needs for surgeons related to Robotics Surgery literacy stemming from the framework's workstreams. Lastly, Health Education England is collaborating with other organisations in digital health from UK, Australia, and New Zealand in a series of round table events exploring common interest areas between the countries in relation to the digital transformation and AI. Thus, this shows how the work behind this framework is intended to help identify ways to bring best practice to NHS services.

Case Study 6.5: International Competency Synthesis Projects TIGER and HITComp

TIGER (***Technology Informatics Guiding Education Reform***), is an influential international initiative, having commenced in 2006, and which has resulted in a series of digital health competency recommendations/frameworks relevant for the EU, the USA, and globally (TIGER 2020). It was led by the HIMMS (***Healthcare Information and Management Systems Society***), an international member-based advisory society focusing on reformation of the global health ecosystem by means of information and technology use (HIMMS, 2023). TIGER provides expertise, leadership, and guidance across various projects in digital health informatics, including curriculum design and education.

In the first phase of the TIGER project, in 2011, HIMMS alongside representatives from 34 countries co-developed a framework consisting of 24 core competency areas across 5 domains (Clinical nursing, Nursing management, Quality management, IT management in nursing, Coordination of interprofessional care). The aim of the document was to guide and stimulate learning to enable personal development in the workplace (Hübner et al., 2018).

The second phase, funded by the Horizon 2020 programme for innovation and research, helped establish a partnership between the TIGER ***International Competency Synthesis Project*** (ICSP) and the EU*US eHealth Work Project. The latter had been set up to identify, map, and give resources supporting needs, gaps, and trends of the eHealth Workforce (2013-16) (HIMMS, 2023). The new joint initiative started in September 2017. This entailed, e.g., a series of international (involving 51 countries) validation and evaluation studies (e.g., Hübner et al., 2016) of the TIGER ***Recommendation Framework*** 1.0 core competencies for practicing nurses. Concurrently, the EU*US eHealth Work Project used these findings to meet their four main aims: (1) to measure, (2) inform, (3) educate and (4) advance eHealth skills, education and knowledge in the EU, the US, and across the world (EU*US eHealth Work 2018).

The findings from the joint initiative were used to create two main outputs. Firstly, the TIGER project published the ***Recommendation Framework*** 2.0 for implementing educational curriculum aimed at increasing digital health skills and knowledge of healthcare professionals across the US, the EU and globally, and to help improve care quality and safety. Secondly, the key output for the EU*US eHealth Work Project team was the competency framework HITComp.

The Recommendations Framework 2.0 was validated globally through surveys and case studies, and it continues to be used to help develop the global workforce in digital health. It consists of 33 competencies (e.g., applied computer science, ethics in health IT, leadership) which were on a fairly high level, but have since been further developed in the HITComp framework (described below). The competencies have been analysed according to their importance related to the various healthcare professions and intra-professional roles (HIMMS, 2020), and therefore they can be adapted to local education contexts and training provisions. To achieve this, the TIGER International Task Force engages in collaborative activities within the interprofessional community (HIMSS, 2023).

The HITComp Tool and Repository (hitcomp.org) builds on the above recommendations and include over 1000 skills and competencies for a wide range of healthcare roles and differing levels of expertise across five domains – Direct Patient Care, Administration, Informatics, Engineering, and Research/Biomedicine. The competencies are collated onto an online platform that is intended to complement various workforce development initiatives in digital health across Europe, the USA, and across the world (EU*US eHealth Work, 2018). The platform also includes a Foundational Curriculum for the workforce in the EU and US in basic skills for health IT and eHealth topics. It can be used by individuals to self-develop, and by educators in healthcare contexts. A detailed curriculum is available here: http://hitcomp.org/education/ (HITComp, 2023).

These frameworks have been translated into usable tools across the globe in digital health learning. We could not find any information on how they have been used in the UK, suggesting a separate approach to digital health education to the rest of EU, even while UK still was an EU member state.

However, the HITComp competency descriptions are somewhat similar to the UK Allied Health Professional competency descriptions from the 2021 framework by NHS Health Education England in that they sit between what we distinguish as competency and as capability in this report.

Case study 6.6: JASeHN eHealth competency model

The JASeHN[42] framework ***Recommendations on A Common Framework for Mapping Health Professionals*** eHealth Competencies (Carrasqueiro 2018) was published in 2018 with the aim to support standardisation of eHealth implementation across the EU member states. It was seen as the "the first step towards (EU) Member-States cooperation for the development of capacity building initiatives to boost eHealth adoption". The framework, inspired by the European eCompetences framework, proposed a conceptual eHealth competences model to be adapted for use by eHealth. The very detailed framework covers 37 professional profiles associated with different stages of an eHealth service's life cycle from its design, development, delivery to evaluation and use: 1) Health – clinical professionals ***involved in the delivery of eHealth***; 2) non-health – administrative and management professionals; and 3) IT roles – management, development, operation and support of eHealth services.

The framework defines 52 competencies[43], each of which comes with a description, mapping with proficiency levels and set of associated knowledge and skills. The three eSkills domains are: ICT practitioner skills; eBusiness skills, and ICT user skills, which covers frontline healthcare staff (see tables 5 and 6 below).

Table 5. *Example of profile statement in JASeHN framework*

Ref	Profile	Summary statement	Mission	Main Tasks	KPI area
P.H.0.1	Healthcare provider /practitioner	Provides healthcare services in accordance with the needs of the individuals / population and with the help of ICTs solutions to share, store and retrieve e-health data, both at the local site or at a distance	Guarantees the provision of quality HC services through the combination of principles and procedures of evidence-based medicine and caring and the functionalities of e-solutions. (Etc.)	(e.g.) Attends patients, at a distance or in person, and diagnoses human illness, injury and other physical and mental impairments based on the available health evidence within the field of their clinical functions. (etc.)	Satisfaction of patients re healthcare provision services.

Table 6. *Example of Knowledge and Skills for Healthcare provider in JAHSeHN framework*

Competence f1	Knowledge	Skill
Communication and integrated HC ICT solutions use	Know the evolution of ICT systems across different healthcare sectors and demonstrate an understanding of the clinical IT systems currently in use.	Use clinical systems to retrieve and record information into clinical records and perform other clinically relevant tasks.

Even if this framework is published only five years ago, it is possible to see how both technology and the way we discuss the required competencies have changed: we no longer talk about 'eHealth' but 'digital health'; 'eSkills' have been replaced by 'digital skills'; and generally, digital competencies are currently being defined as pertaining to the competency battery of ***every*** healthcare professional – not just those specifically involved in the delivery of eHealth services.

Case study 6.7: Digital Competencies for Psychological Professions

The ***Digital Competencies for Psychological Professions*** (2022) has been developed by a sub-committee for the division of Clinical Psychology, and intended for us by "all applied psychologists and psychological practitioners working online and via telephone." While the framework could be visually better organised, it presents a great example of professional practice adapted to a digitally supported environment. Each competency in this framework is directly related to the practice of psychological/psychiatric therapy in a digitally supported context, linked to the required knowledge of e.g., digital therapeutic options and the ability to deliver these in a digital context taking the best care of the patient. The framework also highlights the importance of soft or transferrable skills as part of a successful digitally enabled practice.

The framework starts by defining digital health technologies following NICE 2022 guidelines, as "digital products intended to benefit people or the wider health and social care system". It then lists a range of apps, software and online tools used for treatment or diagnosis, for preventative use or for improvement of systems inefficiencies, or for taking advantage of data. (see table 7)

Table 7. *Example of Competency domain statements in Psychological professions*

Meta competency	Knowledge	Ability
Example:	**Knowledge** of ethical practice, opportunities and limitations of digital practice related to access and efficacy	**Ability** to practice digitally, incl establishing and maintaining a positive therapeutic alliance in online work

The competency framework is preceded by ethical guidelines, which urge professionals to adhere to the usual professional and ethical guidelines that guide their practice.

[42] *Joint Action to Support eHealth Network*

[43] *Competency is defined as "Demonstrated ability to apply knowledge, skills and attitudes for achieving observable results".*

The framework consists of eight competency Domains, with associated Knowledge and Ability requirements hyperlinked to core and advanced competencies:

1. Meta competencies (7 areas of knowledge, and 6 abilities)
2. Clinical information Governance (3 K + 2 A)
3. Assessment and Formulation (7K + 6A)
4. Psychological intervention (6K + 9A)
5. Evaluation and Research (2K + 3A)
6. Comms and Teaching (3K + 5A)
7. Leadership, supervision and consultation (2K + 5A)
8. Personal and professional Skills and Values (1K + 2A)

Case study 6.8: Digital Leadership skills framework

The Digital Health Leadership skills framework has been developed by HEE (2023) to "demonstrate the full breadth of knowledge, skills, abilities, and experiences required by a senior digital health leader who is able to influence digital change and transformation at an organisational level". The framework is intended to be used as part of Digital Health Leadership Programme (DHLP), and assumes sufficient basic digital literacy/competency of the candidates to be able to further develop these skills.

The competency framework lists skills areas and definitions based on competency-based and person-centred dimensions. The competency-based dimension, which has five skills areas, is about "creating a new vision and innovative ideas that are positively related to structural changes to organisational level digital approach for example, updating digital tools, business, processes, operating procedures and planned digital transformation".

The skills areas cover strategic vision; Dissemination of learning; Innovation and change management; Outcomes orientation; and Communication and influence. The person-centred dimension is about "Empowering, influencing, engaging, and motivating others to create a digitally innovative climate which improves performance, readiness for change and collaboration. Understanding self and responsibilities as a leader to maintain confidence, trust and reputation in self, teams, and organisation."

This comes also with five skills areas: Culture development, Team development, Growth mindset, Integrity, and Insightfulness.

Case study 6.9: Data and Digital Literacy for Psychiatrists

Data and digital literacy framework aimed at Psychiatrists in the UK was developed by the Royal College of Psychiatrists (Bachlani et al., 2023). It has been spurred on by the rapid advancement of treatments moving online during the pandemic: Covid-19 translated years of ICT advances into clinical practice within months.

The purpose of the framework is to support "colleagues with their continued use of digital technologies", and to set out a digital data literacy standard for all psychiatrists, recognising that this is a core skill for all those in mental health care. The guidance covers three core themes and five levels of expertise – individual, clinical team, locality level, trust/service level, and systems level.

Core themes are:

- ICES – increasing clinician efficiency and patient safety.
- IPOE – improving patient outcomes and experience.
- EDMH – enabling digital mental health services for patients.

Within each theme, quality improvement methodologies and coproduction underpin the successful delivery of each theme.

For example (Figure 13):

Objective	Theme	Individual/ Personal	Clinical Team	Locality Level	Trust/ Health Board Level	System Level
Target population		**All Doctors**	**SAS/ Consultants working with their multidisciplinary professional team colleagues**	**Medical Lead/ Clinical Director**	**CCIO/ Digital Clinical Lead and Medical Directors**	**System Mental Health representatives/ Medical Directors/ CCIOs**
Agent of change	EDMH	Lead by example in using new digital technologies to improve patient care.	Advocate and support adoption of digital technologies.	Support innovation and QI projects that embrace new digital technologies.	Support widespread adoption and an open culture of new digital technologies that improve patient care and reduce admin burden.	Connect technologies, share best practices and data across healthcare organisations to streamline patient care and improve outcomes.
Online Assessments	EDMH	Can carry out an online MSE.	Online assessments available throughout the team	Parity in online assessment access across teams to meet local population needs.	Parity in online assessment access across the trust.	Parity in online/ virtual assessment access across healthcare organisations.
		Aware of confidentiality and safeguarding issues.	All MDT able to provide online assessments.			
		Are aware of advantages and disadvantages of carrying out online assessment including appropriateness and digital exclusion.	Provide patient choices around modality of patient consultation.			

Figure 13. *Screenshot of the Psychiatrist framework (Bachlani et al., 2023, p.4).*

The most important level of expertise for our review is the "individual level", which has 15 objectives, ranging from being an "Agent of change" and leading by example in using new digital technologies to improve patient care to being able to utilise digital tools (online assessment, EHR, video consultation, mental health apps, social media platforms, etc.), to understanding and being able to use of data in support of clinical practice, understand patient safety and safeguarding issues, online safety, privacy and ethical questions, and for example be able to assess the varying levels of digital capability patients may have to participate digitally.

Confusion over frameworks

While competency and capability have distinct dictionary-based meanings, some of the frameworks we analysed had developed their own definitions, or used the terms interchangeably, if not outright mixing them up. This causes confusion over the purpose, intended use, and required detail the frameworks are expected to offer.

To put it simply, if a framework describes digital skills on a generic level without detailing professional standards or tasks in set healthcare workplace situation, this should be considered a 'capability framework'. Conversely, if a framework describes observable, specific actions performed to a specified professional standard in a specific role, it should be called a 'competency framework'.

Table 8. *Examples of capability and competency statements*

An example of capability	"I understand and adhere to recognised professional standards when using technology." (healthcare professionals) (Ballantyne et al., 2022).[44]
An example of competency	"Appropriately apply data and IT standards in a healthcare setting according to your role, and describe the importance of standards in the process of data sharing" (healthcare professionals/administrative interactions competency quadrant) (EU*US eHealth Work Project & Omni Micro Systems (HIT*Comp*), 2020).

Carrying out content analysis of the frameworks, we found inconsistencies in some frameworks, which were called 'digital competency frameworks', when in fact they had been written up in terms of more general digital capabilities.

Figure 14 (see next page)depicts the different usage of terminology in the 27 frameworks.

Key examples of confusion from our analyses:

1. The NHS HEE (2021) framework for UK Allied Health Professionals (AHPs) is titled as a competency framework, while we also categorised it as 'true' competency framework. It consists of the 'main' framework for all AHPs, and additional 13 competency frameworks for 14 AHPs showing the relevance of the competencies for these professions individually. Despite this, the authors described competencies with a series of capability statements, which do describe general capabilities and are not very specific. Please refer to Chapter 6 for a detailed case study describing this in detail.

2. The NHS Health Education England's (2021n) pharmacy framework was clearly stated as a capability framework. However, it was evaluated by Lee et al. (2023b) with a sample of pharmacists as a competency framework, and unsurprisingly, it was found to be too general to be one, missing measurable in-service digital tasks. We infer that 'competency' is applied here due to describing specific profession expectations or standards, however, the actual write-up of the frameworks does not include a professional standard; but rather a growth-oriented set of guidelines for professional development of the pharmacy workforce in relation to digital health.

3. In nursing, term 'competency' is ingrained into the professional terminology to refer to various standards and expectations at work, as outlined in professional standards publications for nurses. It was noticed that perhaps due to this professional lens, authors of digital health frameworks aimed at nursing refer to competencies rather than capabilities. For example, Nursing and Midwifery Board of Ireland (NMBI) (2023) adapted the Health and Social Care (2022) framework changing the 'capability' to 'competency', and even while referencing the NMBI framework directly.

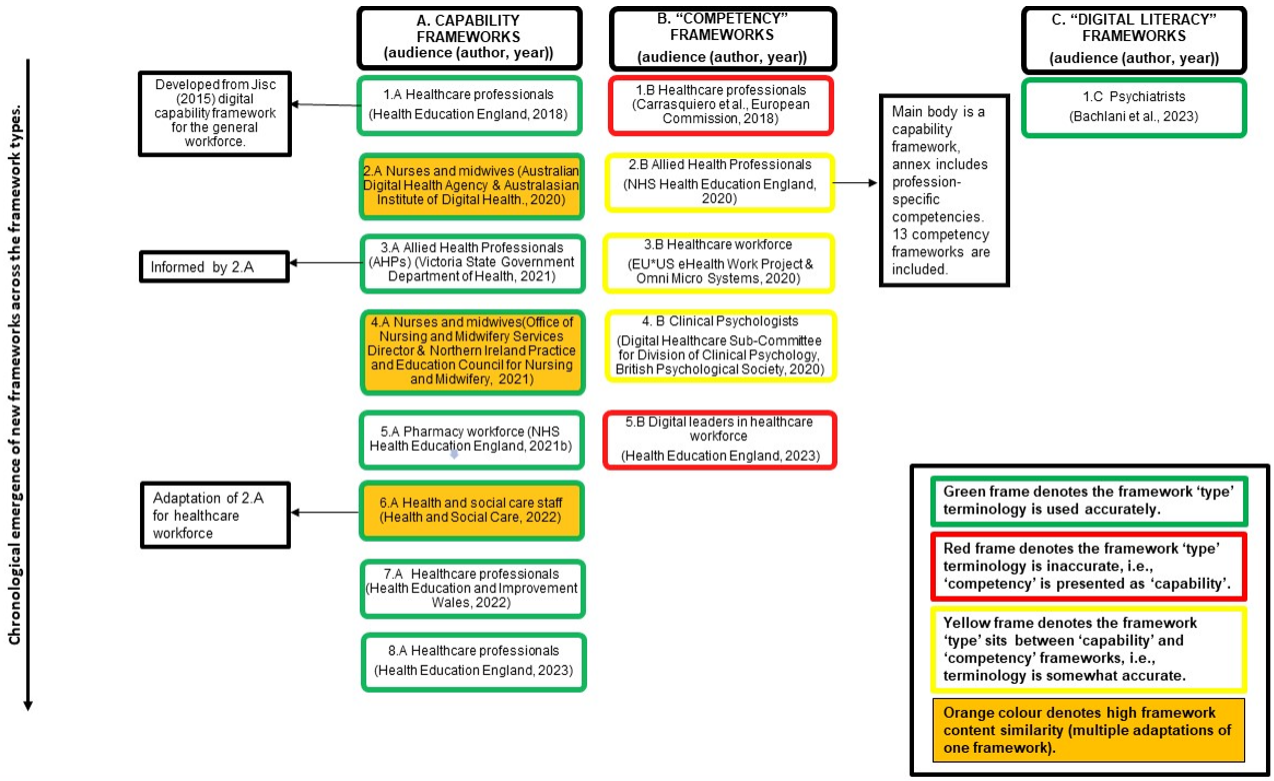


Figure 14. *Capability, competency, and literacy frameworks from our analysis (27 frameworks in total), presented chronologically, and labelled according to their framework type name accuracy. Additional notes available where appropriate. Please see Appendix 3 for the full list of references.*

V - Discussion

The proliferation of frameworks, and how they have evolved over time, reflect the pace of digital transformation of health and care in certain areas of the world. There are also countries where such basic frameworks intended to support digital working are still few, or not required. This can either be due to a higher general digital literacy among the population, or digital training being part of professional training of frontline staff, such as in the Nordic countries; or because certain countries have not yet reached required levels of digital maturity for the health and care services to have become digitalised.

The language used in the frameworks signals the shifting technology, the digital maturity of a given context, and with that, the changing requirements placed upon healthcare workforce in terms of their skills and capability/competency requirements. The frameworks seem to evolve incrementally, and often share the key digital capability/competency domains, albeit in slightly modified versions. The frameworks have moved from informatics skills for nurses to general e-skills and ICT-literacy for those working specifically in e-health to 'e-health skills', then onto digital literacy and digital capability for the general workforce, and most recently, to skills required to work within an environment supported by AI and robotics as part of health and care delivery. For a long time, the frameworks referred to this domain as 'e-health', whereas 'digital capabilities for health and social care' combination has started creeping into the frameworks in early 2020s.

The review also highlights the unstandardised use of terminology, and differences in how 'capability', 'competency' or 'literacy' are being defined and used, something that has contributed to the confusion over the intended purpose and usefulness of each framework. Furthermore, while 'digital skills' is a common way to refer to digital capabilities or competencies, and while in fact this study started by looking specifically into 'digital skills frameworks', we found not a single framework that is called a 'digital skills framework'.

The review of the selected frameworks published since 2018 and intended to support digital working of the frontline healthcare workforce shows the different traditions and approaches in place to do that. The NHS frameworks have emerged from the person-centred digital literacy tradition with the aim to support personal development in the digital ways of working, while the Australian-Irish frameworks stem from a more profession-focussed understanding of capability, which encompasses professional competency. The international (European—US) competency frameworks have taken professional standards as their starting points, tying digital skills to specific job roles and tasks. These international frameworks are well-researched and collaboratively developed striving for standardised digital practices and shared effort, with shared resources made available in multiple languages. The UK seems to have adopted a different path in supporting digital working of healthcare workforce with 17 out of the 57 frameworks that emerged from the first search being developed within the UK, all published between 2011-21. This may be down to the federated nature of the NHS, where there is little coordination between the different regions, and where individual health boards or professional bodies have sought to develop their own frameworks for use by their staff.

Out of all the frameworks reviewed in this study, ***the AI and Digital Healthcare Technologies*** (HEE et al., 2023) framework is the most up to date and the most future-oriented framework, taking into account the accelerating technology development, the changing landscape of work, and the increasing fluidity in job roles in health and care, something that is beautifully captured in the use of archetypes, and that the different archetypes require different levels of proficiency with digital technologies to do their jobs. While the title of the framework emphasises AI and digital technologies, the capability requirements per archetype are entwined with the practice of person-centred digitally enabled delivery of care, and supporting digital transformation of health and care.

Like the extensive international digital competency frameworks HITComp and JASeHN, the AI and Digital Healthcare Technologies framework considers the broader workforce and the entire lifecycle of digital health and care.

However, while the international frameworks are extensive and well-researched, their terminology remains old-fashioned, and the detail to which they go to per professional role and task will be challenging to keep up to date to reflect the fast pace of technology change and the increasing fluid nature of professional roles in health and care. The AI and Digital Healthcare Technologies framework has been created to be agile and flexible, while the massive competency frameworks will struggle to keep abreast the pace of change.

Digital Competencies framework for Psychological Professions is a great example of a competency framework: it is job specific and closely enough tied to professional best practice, but with space to grow and change. The NHS framework intended for use for all AHPs has failed to quite hit the mark because it is presented as a competency framework when it has been built upon capability statements, which are on a higher, more aspirational level.

As seen in the AHPs frameworks case study (6.3.), both the UK and Australian frameworks describe general capability statements. However, the UK framework specified each statement's importance and relevance to every role within the domains, making its capability statements more competency-like. However, we still concur that these frameworks require further specificity to be useful to AHPS wishing to develop their digital abilities in given healthcare setting.

In the next section of the report, we propose some recommendations for professional self-development, education and training provision based on the insights from this review.

VI - Conclusions and Recommendations

There are numerous, readily available, comprehensive frameworks to support digital working in healthcare worldwide, with demonstrably shared key areas of digital capability or competency. We are beginning to witness the emergence of frameworks that assume different levels of digital literacy for their users (cf. NHS HEE 2018 vs. NHS HEE, 2023).

New frameworks become relevant when new digital innovations emerge and are appropriated for use by healthcare service and delivery. This includes changes in legislation, regulations, and culture, etc. Adoption/adaptation or the development of a new framework may become relevant also when the maturity of the digital healthcare system advances, and the staff have higher levels of digital literacy.

Based on the review of key examples of frameworks which have seen real-world application across healthcare services, we recommend the following:

- Considering the wealth of well-developed frameworks intended to support digital working in healthcare, we recommend that organisations use, or adapt for use in the local context, one of the existing frameworks.
    - There are frameworks that support the development of generic digital literacy levels, which are suitable when the staff digital literacy is not very high.
    - There are frameworks aimed at more mature digital infrastructure and staff with higher digital literacy, which will be useful to their development.
    - There are extensive and detailed job-specific digital competency frameworks aligned with professional standards for most professional categories in healthcare, which could help with creating skills assessment frameworks, educational materials or in drafting job specifications – if these are up to date.
- Organisations are encouraged to find effective ways to assess the digital maturity levels of their service, and the digital literacy levels of their staff, as well as to consider what type of capacity is required to be build: is there a need to support the development of generic digital capabilities and the ability to continually update one's digital skills, or does the organisation wish to support the more job role specific digital competencies that meet professional standards? These decisions will guide with the selection of the context-specific education and training opportunities and the associated framework(s) to use.
- In developing a new framework, we strongly advise standardising the terminology by which digital capability/competency/literacy and skills are used, and/or being clear on which definition each framework is based on.
- We further recommend implementing digital as core part of curricula for future health and social care workforce across further and higher education. This is essential in combatting and helping to plan future need for frameworks in a given setting.
- With the view of the fast-paced technology change and the emergence of unspecified and fluid job roles, we recommend following the agile approach taken by the team who developed the NHS HEE (2023) ***AI and Digital Health Technologies framework***, which uses archetypes or personas for specifying job types instead of strict professional roles. Personas allow defining varied digital proficiency levels for the different roles, as well as provide a more flexible way to denote required digital capabilities or competencies in a changing world.
- Frameworks should also be used to identify current and emergent skills shortages or skills gaps in business units in order to provide appropriate opportunities for upskilling and training.
- While the NHS HEE (2023) framework provides archetypes that cover even the specialist Knowledge, Information, Data and Digital (KIND) workforce as well as the technical staff working in health and care, further research should be carried out, for example, in analysing frameworks used to support digital working by social care workforce.

Bibliography

Ala-Mutka, K. (2011). Mapping Digital Competence: Towards a conceptual understanding (No. JRC67075-2011). Luxembourg: European Commission JRC Institute for Prospective Technological Studies.

American Nurses Organisation. (2008). (publication). ANA's Health System Reform Agenda. Silver Spring, Maryland: American Nurses Association. Retrieved September 4, 2023, from file:///C:/Users/rgb22119/Downloads/silo.tips_health-system-reform-agenda.pdf.

Anastasiou, K., & Smith, D. (2023). Development of a Conceptual Framework to Identify and Clarify the Concept of Digital Skills in the Healthcare Sector. Aesculapius Journal (Health Sciences & Medicine), 4(1). https://red.library.usd.edu/aesculapius/vol4/iss1/1

Australian Digital Health Agency & Australasian Institute of Digital Health. (2020). National Nursing and Midwifery Digital Health Capability Framework. Australian Government. https://www.digitalhealth.gov.au/sites/default/files/2020-11/National_Nursing_and_Midwifery_Digital_Health_Capability_Framework_publication.pdf

Australian Medical Council Ltd. (2021). Capability Framework on Digital Health in Medicine. https://www.amc.org.au/wp-content/uploads/2021/10/Digital-Health-in-Medicine-Capability-Framework-FINAL-18-Oct-2021.pdf

Bachlani, A., Runciman, R., Dave, S., Bradley, P., Reza, H., Rahim, A., Vinjamuri, I., Moore, S., & Tracy, D. (2023). Data and Digital Literacy for Psychiatrists. Royal College of Psychiatrists. https://www.rcpsych.ac.uk/training/curricula-and-guidance/Digital-Literacy-Framework

Ballantyne, L. D. (2022, March 14). A Digital Capability Framework for Healthcare: Demo Version. LinkedIn. https://www.linkedin.com/pulse/digital-capability-framework-healthcare-demo-version-lee-d-ballantyne/

Brice, S., & Almond, H. (2020). Health Professional Digital Capabilities Frameworks: A Scoping Review. Journal of Multidisciplinary Healthcare, 13, 1375–1390. https://doi.org/10.2147/JMDH.S269412

Brunner, M., McGregor, D., Keep, M., Janssen, A., Spallek, H., Quinn, D., Jones, A., Tseris, E., Yeung, W., Togher, L., Solman, A., & Shaw, T. (2018). An eHealth Capabilities Framework for Graduates and Health Professionals: Mixed-Methods Study. Journal of Medical Internet Research, 20(5), e10229. https://doi.org/10.2196/10229

Cairns, L. (2000, May). The process/outcome approach to becoming a capable organisation. In Australian Capability Network Conference (pp. 1-14). Sydney. (Unpublished paper

Carrasqueiro, S. (2018). Recommendations on A Common Framework for Mapping Health Professionals' eHealth Competencies. Joint Action to support the eHealth Network. https://web.archive.org/web/20201211034628/https://jasehn.eu/wordpress/wp-content/uploads/2018/07/JAseHN_D7.1.3_RECOMMENDATIONS_common_Framework_mapping_health_profession….pdf

(CEN) European Committee for Standardization. (2008). European e-Competence Framework 1.0. https://web.archive.org/web/20090306145102/http://www.ecompetences.eu/site/objects/download/4756_EuropeaneCompetenceFramework1.0.pdf

Central Digital and Data Office. (2017). Digital, Data and Technology Profession Capability Framework. GOV.UK. https://www.gov.uk/government/collections/digital-data-and-technology-profession-capability-framework

Council of European Professional Informatics Societies CEPIS. (1996). European computer driving licence | ECDL Project | Fact Sheet | FP4. CORDIS | European Commission. Retrieved 14 November 2023, from https://cordis.europa.eu/project/id/22561

Council Recommendation of 22 May 2018 on key competences for lifelong learning. Official Journal of the European Union, 2018, 2018/C 189/01. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.C_.2018.189.01.0001.01.ENG&toc=OJ%3AC%3A2018%3A189%3ATOC

Demchenko, Y., Brewer, S., José, C. G. J., & Wiktorski, T. (2017). EDISON Data Science Framework (EDSF): Addressing demand for data science and analytics. http://www.uazone.org/demch/papers/educon2021-edsf-4data-driven-digital-v02.pdf

Demchenko, Y., Wiktorski, T., Gallego, J. C., & Brewer, S. (2019, September). EDISON data science framework (eds) extension to address transversal skills required by emerging industry 4.0 Transformation. In 2019 15th International Conference on eScience (eScience), 553-559. https://doi.10.1109/eScience.2019.00076.

Department of Health and Human Services (2019). Allied health career pathways blueprint, State of Victoria, Melbourne.

Digital Health & Care Institute. (2019). Our Time to Shine: Empowering the Data, Information and Knowledge Workforce as a Driving Force for Digital Health and Care [Report]. Digital Health & Care Institute. https://doi.org/10.17868/69331

Digital Healthcare Sub-Committee for Division of Clinical Psychology, British Psychological Society. (2022).

Digital Competencies for Psychological Professions. DigitalHealthSkills.Com. https://digitalhealthskills.com/digitalcompetencies/

Digital Literacy Courses, Programs & Resources: Microsoft Digital Literacy. Microsoft. (2022). https://www.microsoft.com/en-us/digital-literacy

DQ Institute. (2019). DQ Global Standards Report 2019: Common Framework for Digital Literacy, Skills & Readiness [DQ Global Standards Report 2019]. DQ Institute. https://www.dqinstitute.org/wp-content/uploads/2019/03/DQGlobalStandardsReport2019.pdf

European Commission (2020) COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS Digital Education Action Plan 2021-2027 Resetting education and training for the digital age. Eur-Lex. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020DC0624 (Accessed: 23 August 2023).

European Commission. (2021). SELFIEforTEACHERS | Home. SELFIE for TEACHERS Supporting Teachers in Building Their Digital Competence. https://educators-go-digital.jrc.ec.europa.eu/

European Health Parliament. (2016). DIGITAL SKILLS FOR HEALTH PROFESSIONALS. https://www.healthparliament.eu/digital-skills-health-professionals/

EU Science Hub. (2016). The Digital Competence Framework for Consumers. https://joint-research-centre.ec.europa.eu/digital-competence-framework-consumers_en

EU*US eHealth Work. (2018). EU*US ehealth work. http://ehealthwork.org/

EU*US eHealth Work Project & Omni Micro Systems. (2020). Health Information Technology Competencies (HITComp) [HITComp]. http://hitcomp.org/competencies/

Gilster, P. (1997). Digital literacy. New York; Chichester: John Wiley. http://archive.org/details/digitalliteracyoooogils

Gu, D., Yang, X., Deng, S., Liang, C., Wang, X., Wu, J., and Guo, J. (2020) 'Tracking Knowledge Evolution in Cloud Health Care Research: Knowledge Map and Common Word Analysis', Journal of medical Internet research, 22(2), pp. e15142. doi:10.2196/15142

Hager, P., & Beckett, D. (1995). Philosophical underpinnings of the integrated conception of competence. Educational Philosophy and Theory, 27(1), 1–24. https://doi.org/10.1111/j.1469-5812.1995.tb00209.x

Health Education England. (2023). Digital Health Leadership skills framework. Health Education England: Digital Transformation. https://digital-transformation.hee.nhs.uk/digital-academy/programmes/digital-health-leadership-programme/digital-health-leadership-skills-framework

Health Education England; Davies, A., Abdulhussein, H., Davies, A., Nix, M., & Painter, A. (2023). Artificial Intelligence (AI) and Digital Healthcare Technologies Capability framework. Health Education England | Digital Transformation. https://digital-transformation.hee.nhs.uk/building-a-digital-workforce/dart-ed/horizon-scanning/ai-and-digital-healthcare-technologies

Health Education England & Royal College of Nursing. (2017). Improving Digital Literacy.

Health Education and Improvement Wales. (2022). Digital capability framework for healthcare in Wales (pilot). https://heiw.nhs.wales/news/digital-capability-framework-for-healthcare-in-wales-pilot/

Health and Social Care. (2022). All-Ireland Digital capability Framework for Health and Social Care. The Health Service Executive and Digital Health and Social Care Northern Ireland. https://www.health-ni.gov.uk/publications/all-ireland-digital-capability-framework

HIMSS. (2023, November 2). Who we are. https://www.himss.org/who-we-are

HITCOMP. (2023). Education: HITCOMP. About the Education Tab. http://hitcomp.org/education/

Huvila, I. (2012). 3—Information services and digital literacy. In I. Huvila (Ed.), Information Services and Digital Literacy (pp. 25–34). Chandos Publishing. https://doi.org/10.1016/B978-1-84334-683-8.50003-3

Hübner, U., Shaw, T., Thye, J., Egbert, N., Marin, H., & Ball, M. (2016). Towards an International Framework for Recommendations of Core Competencies in Nursing and Inter-Professional Informatics: The TIGER Competency Synthesis Project. Studies in health technology and informatics, 228, 655–659.

Hübner, U., Shaw, T., Thye, J., Egbert, N., Marin, H. F., Chang, P., O'Connor, S., Day, K., Honey, M., Blake, R., Hovenga, E., Skiba, D., & Ball, M. J. (2018). Technology Informatics Guiding Education Reform - TIGER. Methods of information in medicine, 57(S 01), e30–e42. https://doi.org/10.3414/ME17-01-0155

ICDL. (2021). ICDL References & Endorsements, Digital Skills for Employability and Productivity. ICDL. https://icdl.org/app/uploads/2021/11/ICDL-References-Brochure-English-2021-Web-.pdf

ICDL. (2022). ICDL. ICDL Global. https://icdl.org/

ICDL Asia. (2015). The History of ICDL and ECDL. ICDL International Computer Driving License. http://icdlcenter.com/about/our-history.html

ICDL Europe. (2023). ICDL Europe—About Us. ICDL Europe. https://icdleurope.org/about-us/#:~:text=CEPIS%20task%20force%20creates%20ECDL%20concept&text=The%20new%20certification%20programme%20was,in%20Sweden%20in%20August%201996.

ICDL Org. (2023). About Us. ICDL Global. https://icdl.org/about-us/

Institute for Prospective Technological Studies (Joint Research Centre), Punie, Y., Ferrari, A., & Brečko, B. N. (2013). DIGCOMP: A framework for developing and understanding digital competence in Europe. Publications Office of the European Union. https://data.europa.eu/doi/10.2788/52966

INTEF (2017). Common Digital Competence Framework for Teachers. National Institute of Educational Technologies and Teacher Training, Ministry of Education, Culture and Sport, Spanish Government. https://aprende.intef.es/sites/default/files/2018-05/2017_1024-Common-Digital-Competence-Framework-For-Teachers.pdf

ISTE International Society for Technology in Education. (2017). ISTE Standards for Students. A Practical Guide for Learning with Technology. Library on Congress. https://cdn.iste.org/www-root/Downloads/Downloads/Download-4074.pdf

ISTE. (2023). Standards. https://iste.org/standards

Joint Research Centre (European Commission), Punie, Y., Pujol Priego, L., Carretero, S., Vuorikari, R., Cabrera, M., Kluzer, S., & O'Keeffe, W. (2018). DigComp into action, get inspired make it happen: A user guide to the European Digital Competence framework. Publications Office of the European Union. https://data.europa.eu/doi/10.2760/112945

Jisc. (2014, October 7). The seven elements of digital literacies. https://web.archive.org/web/20141011143516/http://www.Jiscinfonet.ac.uk/infokits/digital-literacies/

Jisc. (2015a). Digital Capabilities: The 6 elements defined. https://digitalcapability.Jiscinvolve.org/wp/files/2015/06/1.-Digital-capabilities-6-elements.pdf

Jisc. (2015b). Six elements of digital capability. Jisc Building Digital Capability Blog. https://digitalcapability.Jiscinvolve.org/wp/2015/06/11/revisiting-digital-capability-for-2015/

Law, N., Woo, D., de la Torre, J., & Wong, G. (2018). A Global Framework of Reference on Digital Literacy Skills for Indicator 4.4.2. UNESCO Institute for Statistics, UNESCO. https://uis.unesco.org/sites/default/files/documents/ip51-global-framework-reference-digital-literacy-skills-2018-en.pdf

Lee, G., Caton, E., & Knight, A. (2023a). Evaluating digital competencies for allied health professionals in the United Kingdom. DIGITAL HEALTH, 9, 20552076231176656. https://doi.org/10.1177/20552076231176658

Lee, G., Caton, E., & Ding, A. (2023b). Evaluating digital competencies for pharmacists. Research in Social and Administrative Pharmacy, 19(5), 753–757. https://doi.org/10.1016/j.sapharm.2023.01.012

Lennon, M., Kirsch, I., Von Davier, M., Wagner, M., & Yamamoto, K. (2003). Feasibility Study for the PISA ICT Literacy Assessment: Report to Network A. Educational Testing Service.

Loewus, L. (2016, November 8). What Is Digital Literacy? Education Week. https://www.edweek.org/teaching-learning/what-is-digital-literacy/2016/11

Martin, A., & Grudziecki, J. (2006). DigEuLit: Concepts and Tools for Digital Literacy Development. Innovation in Teaching and Learning in Information and Computer Sciences, 5(4), 249–267. https://doi.org/10.11120/ital.2006.05040249

Martínez-Bravo, M. C., Sádaba Chalezquer, C., & Serrano-Puche, J. (2022). Dimensions of Digital Literacy in the 21st Century Competency Frameworks. Sustainability, 14(3), Article 3. https://doi.org/10.3390/su14031867

Misheva, G. (2021, April 21). DigComp: The EU Digital Competence Framework | Digital Skills & Jobs Platform. https://digital-skills-jobs.europa.eu/en/actions/european-initiatives/digital-competence-framework-digcomp

Morrison, C., Rimpiläinen, S., Bosnic, I., Thomas, J., & Savage, J. (2022). Emerging Trends in Digital Health and Care: A Refresh Post-COVID [Report]. Digital Health & Care Institute. https://doi.org/10.17868/strath.00082203

Nazeha, N., Pavagadhi, D., Kyaw, B. M., Car, J., Jimenez, G., & Car, L. T. (2020). A Digitally Competent Health Workforce: Scoping Review of Educational Frameworks. Journal of Medical Internet Research, 22(11), e22706. https://doi.org/10.2196/22706

National Health Service (NHS) (2017). Improving digital literacy, National Health Service, London

NHS Health Education England. (2018). A Health and Care Digital Capabilities Framework. NHS. https://www.leadershipbyall.co.uk/wp-content/uploads/2021/04/Digital-Literacy-Capability-Framework-2018.pdf

NHS Health Education England. (2021). Development of a digital competency framework for UK Allied Health Professionals—2020 Topol Digital Health Fellowship. NHS Health Education England. https://allcatsrgrey.org.uk/wp/wpfb-file/development-of-a-digital-competency-framework-for-uk-ahps-pdf/

NHS Health Education England. (2021a). Digital Competencies for Diagnostic Radiography. https://healtheducationengland.sharepoint.com/:w:/g/Comms/Digital/EQObsU_EUZpPgejczMz9cZcBmmCwapoFgTxoqfh-vUHWBQ?e=GHFVQX

NHS Health Education England. (2021b). Digital competencies for Art Therapy. NHS HEE. https://healtheducationengland.sharepoint.com/:w:/g/Comms/Digital/EZQTAjrJsIZCl-qJ45h1AH4BnwakiIMHVKDinxUvtq9eyA?e=CeHtYm

NHS Health Education England. (2021c). Digital competencies for Dietetics. NHS HEE. https://healtheducationengland.sharepoint.com/:w:/g/Comms/Digital/EQrdQ6B1NqBPqfolB5olVUQB_cbviLq5UPTRXtFHJzuNiA?e=dGleQz

NHS Health Education England. (2021d). Digital competencies for Occupational Therapy.

NHS HEE. https://healtheducationengland.sharepoint.com/:w:/g/Comms/Digital/EWoqBiot2KNNh9lM9KqM5CsBKHqyD1xIdt8PNKngtpuqkQ?e=nFRbvv

NHS Health Education England. (2021e). Digital competencies for Operating Department Practitioners. NHS HEE. https://healtheducationengland.sharepoint.com/:w:/g/Comms/Digital/EWGA-9jIPP1LsBg7F9sQSQMB3ROCgX-n1R9MnnEg_nQVMA?e=HkcKZL

NHS Health Education England. (2021f). Digital Competencies for Orthosis. NHS HEE. https://healtheducationengland.sharepoint.com/:w:/g/Comms/Digital/EWGA-9jIPP1LsBg7F9sQSQMB3ROCgX-n1R9MnnEg_nQVMA?e=HkcKZL

NHS Health Education England. (2021g). Digital competencies for Orthotists/Prosthesis.

NHS HEE. https://healtheducationengland.sharepoint.com/:w:/g/Comms/Digital/EavVrrAAe2dKqJk8qr1JdB4BGCQVFHoda6WUb2IidmoSEw?e=79gVhc

NHS Health Education England. (2021h). Digital competencies for Osteopathy. NHS HEE. https://healtheducationengland.sharepoint.com/:w:/g/Comms/Digital/ESi2XOL9O1ZBqjePZzEoA_MBoyLFYQQrNU4V6fIPkBhi6Q?e=hohocz

NHS Health Education England. (2021i). Digital competencies for Paramedics. https://healtheducationengland.sharepoint.com/:w:/g/Comms/Digital/EV_p7yzl6VNCvZ6AECCJ_8sB1FmwkyElhwExooI8zi6AUQ?e=jydJ2m

NHS Health Education England. (2021j). Digital competencies for Physiotherapy.

NHS HEE. https://healtheducationengland.sharepoint.com/:w:/g/Comms/Digital/EfZLKPpCiDpOocqsrubrS3YBRltzOrROhgIaylKalr2pag?e=x6OWVD

NHS Health Education England. (2021k). Digital competencies for Podiatry/Chripody.

NHS HEE. https://healtheducationengland.sharepoint.com/:w:/g/Comms/Digital/ES1cTGk5kUxPivfMNPT460QBr3INdu4fcZyXEfpatIgCpg?e=Ze5ize

NHS Health Education England. (2021l). Digital competencies for Speech and Language Therapy. NHS HEE. https://healtheducationengland.sharepoint.com/:w:/g/Comms/Digital/EUgfTVjhMsZGsg1HOkjkRQ4B7WFq-qbp-Gx21vk-1Kcvmw?e=GS8psR

NHS Health Education England. (2021m). Digital competencies for Therapeutic Radiology. NHS HEE. https://healtheducationengland.sharepoint.com/:w:/g/Comms/Digital/EenmFe-pa-VOsY3QKS9BSdABlUJrJnQXKm21gAtr27IaUw?e=qd5qE2

NHS Health Education England. (2021n). Digital Capabilities for the Pharmacy Workforce. Health Education England. https://www.hee.nhs.uk/sites/default/files/Supporting%20Digital%20Literacy%20in%20the%20Pharmacy%20Workforce%20-%20June%202021.pdf

NHS Health Education England. (2023b, February 21). AI and Digital Healthcare Technologies Capability framework published. NHS choices. https://www.hee.nhs.uk/news-blogs-events/news/ai-digital-healthcare-technologies-capability-framework-published

NHS Health Education England. (2023c). What is digital literacy? Digital Transformation. https://digital-transformation.hee.nhs.uk/building-a-digital-workforce/digital-literacy/what-is-digital-literacy

Nursing & Midwifery Board of Ireland (NMBI). (2023). Digital Health Competency Standards and Requirements for Undergraduate Nursing and Midwifery Education Programmes (First Edition). https://www.nmbi.ie/Education/Standards-and-Requirements/Digital-Health-Competencies

Oberländer, M., Beinicke, A., & Bipp, T. (2020). Digital competencies: A review of the literature and applications in the workplace. Computers & Education, 146, 103752. https://doi.org/10.1016/j.compedu.2019.103752

Office of Nursing and Midwifery Services Director & Northern Ireland Practice and Education Council for Nursing and Midwifery. (2021). All-Ireland Nursing & Midwifery Digital Health Capability Framework. https://healthservice.hse.ie/filelibrary/onmsd/all-ireland-nursing-midwifery-digital-health-capability-framework.pdf

Park, Y. (Ed.). (2019). (rep.). DQ Global Standards Report 2019 Common Framework for Digital Literacy, Skills and Readiness. DQ Institute. Retrieved November 21, 2023, from https://www.dqinstitute.org/wp-content/uploads/2019/11/DQGlobalStandardsReport2019.pdf.

Pengel, J., Wullf, S., Meißner, A., Borcherding, G., & Hülsken-Giesler, M. (2022). Digital competency frameworks for nursing: A scoping review. 1–29. https://doi.org/10.25528/119

Public Health England, Digital-first public health: Public Health England's digital strategy (2017). Retrieved November 16, 2023, from https://www.gov.uk/government/publications/digital-first-public-health/digital-first-public-health-public-health-englands-digital-strategy.

Rimpiläinen, S., Morrison, C., & Rooney, L. (2018). Review and Analysis of the Digital Health Sector and Skills for Scotland: A Report by the Digital Health and Care Institute in Partnership with Skills Development Scotland [Report]. University of Strathclyde. https://doi.org/10.17868/63863

Rimpiläinen, S., Morrison, C., Nielsen, S. L., & Rooney, L. (2019). Spotlight on Careers in Digital Health and Care: Addressing Future Workforce Development Needs in Digital Health and Care. Digital Health & Care Institute. https://strathprints.strath.ac.uk/69247/

Rimpilainen, S. (2022, June 9). Future healthcare staff still 'largely being trained to work in the non-digital world', review finds. FutureScot. https://futurescot.com/future-healthcare-staff-still-largely-being-trained-to-work-in-the-non-digital-world-review-finds/

Sáez, F. T., Jiménez, D. A., San Martín, M. J. G., Rodríguez, R. M., Robles, A. S., Santos, J., & Ojeda, M. A. (2020). Global Framework for Educational Competence in the Digital Age. ProFuturo. https://profuturo.education/wp-content/uploads/2020/10/MarcoProFuturo_Resumen-ejecutivo_ENG-online.pdf

Scott, I. A., Shaw, T., Slade, C., Wan, T. T., Coorey, C., Johnson, S. L. J., & Sullivan, C. M. (2023). Digital health competencies for the next generation of physicians. Internal Medicine Journal, 53(6), 1042–1049. https://doi.org/10.1111/imj.16122

Scottish Government. (n.d.). Digital, Data and Technology profession, skills and capability. http://www.gov.scot/policies/digital/digital-data-technology-profession/

SFIA. (2021, September). SFIA 8 [Page]. SFIA. https://sfia-online.org/en/sfia-8

SFIA. (2023, April 18). SFIA 8. https://sfia-online.org/en/sfia-8/sfia-8

Technology Informatics Guiding Education Reform (TIGER). (2020). TIGER International Competency Synthesis Project: Global Health Informatics Competency Recommendation Frameworks. https://www.himss.org/sites/hde/files/media/file/2021/01/29/tiger-icsp-recommendations.pdf

Tinmaz, H., Lee, Y.-T., Fanea-Ivanovici, M., & Baber, H. (2022). A systematic review on digital literacy. Smart Learning Environments, 9(1), 21. https://doi.org/10.1186/s40561-022-00204-y

UK Government, UK Digital Strategy 2017 (2017). London; UK Government

Victoria State Government Department of Health. (2021). Digital health capability framework for allied health professionals. Victorian Government, Australia. https://www.health.vic.gov.au/digital-health/the-digital-health-capability-framework-for-allied-health-professionals

Vuorikari, R., Kluzer, S., & Punie, Y. (2022a, March 17). DigComp 2.2: The Digital Competence Framework for Citizens - With new examples of knowledge, skills, and attitudes. JRC Publications Repository. https://doi.org/10.2760/115376

Vuorikari, R., Kluzer, S. and Punie, Y. (2022b). DigComp 2.2. The Digital Competence Framework for Citizens - With new examples of knowledge, skills and attitudes, EUR 31006 EN, Publications Office of the European Union, Luxembourg. doi:10.2760/490274, JRC128415.

Appendices

Appendix 1

Table 9. Chronological list of the initial 57 digital skills frameworks (targeting workforce, specialist data staff, and citizens) based on first publishing year, including latest version information, location, continent, title, author, and intended audience.

c	First pub-lished	Year latest	v	Location	Continent	Title	Author	Target audience
1.	1995	2008	3	USA	North America	Nursing informatics: scope and standards of practice	The American Nurses Associ-ation	nurses
2.	1996	na	1	Europe	Europe	International Computer Driving Licence (ECDL)	the Council of European Profes-sional Informatics So-cieties (CEPIS)	European countries
3.	1998	2019	4	Global	Global	The International Society for Technology in Educa-tion (ISTE) Standards	ISTE	individuals and organisations
4.	1999	2022	5	Global	Global	International Computer Driving License (ICDL)	ICDL	Individuals and organisations across pro-fessions
5.	2000	2022	8	Global	Global	Skills Framework for the Information Age (SFIA) 8	SFIA	SFIA can be used across multi-ple indus-tries and organisa-tional types. It's an ideal framework, whether for individuals, small and large teams, departments or busi-ness func-tions, small and medium-sized enterprises, or entire organisations with thousands of employees.
6.	2008	2016	3	EU	Europe	European e-Competence Framework 3.0	European Committee for Standardiza-tion (CEN)	information professionals
7.	2009	2019	2	Global	Europe and USA	Technology Informatics Guiding Educational Re-form (TIGER)	Technology Informatics Guiding Ed-ucational Re-form (TIGER)	nurses

c	First pub-lished	Year latest	v	Location	Continent	Title	Author	Target audience
8.	2011	na	1	Scotland	Europe	Ehealth Competency Framework (defining the role of the expert clinician)	Academy of Medical Royal Colleges (Scottish Government)	medical and dental practitioners
9.	2012	2022	2	Canada	North America	USE, UNDERSTAND & ENGAGE: A Digital Media Literacy Framework for Canadian Schools	Mediasmarts	Education and training
10.	2012	2022	2	Singapore	Asia	SkillsFuture - Skills Frame-work for Info-comm Technology	Government of Singa-pore	Individuals and organisations and training providers
11.	2013	2016	2	EU	Europe	The European Digital Competence Frame-work (DigiComp) 2.2	European Commission/ EU Science Hub	orga
12.	2013	2022	6	North America	North America	IC3 (Internet Core Compe-tency Certifica-tion) Digital Literacy Global Standard	Certiport	Individuals, organisations, train-ing providers and employers
13.	2014	na	1	UK	Europe	Building digital capability	JISC	digital leaders and staff in health and social care, students in edu-cational setting
14.	2015	na	1	India	Asia	National Digital Literacy Mission (NDLM) Scheme	Government of India	Individuals and organisations
15.	2015	na	1	Canada	North America	British Columbia's Digital Literacy Frame-work	Province of British Columbia	Education and training
16.	2016	na	1	UK	Europe	Core digital skills model in social care	Skills for Care	social care workforce
17.	2016	2017	2	EU	Europe	EDISON Data Science Competence Frame-work (CF-DS) (EDSF)	EU Comission in part-nership with various universities and pro-fes-sionals (EDISON project)	organisations and individuals

c	First pub-lished	Year latest	v	Location	Continent	Title	Author	Target audience
18.	2017	na	1	EU	Europe	DigiCompEdu	European Union	Teachers/trainers
19.	2017	na	1	Norway	Europe	Professional Digital Com-petence Framework for Teachers	Norwegian Centre for ICT in educa-tion	education
20.	2017	na	1	Spain	Europe	Common Digital Com-petence Framework for Teachers (CDCFT)¶	National Institute of Ed-ucational Technologies and Teacher Training	education
21.	2017	2022	7	UK	Europe	Digital, Data and Technol-ogy Profession Capability Framework (DDaT)	UK Government	individuals/organisations
22.	2018	na	1	England	North America	A Health and Care Digital Capabilities Framework	UK Government/ Health Education Eng-land	individuals and organisations in health and social care
23.	2018	2019	1	UK	Europe	Essential Digital Skills Framework	UK Government	everyone in UK supporting adults
24.	2018	na	1	Kenya	Africa	Digischool: The Digital Literacy Programme	UNESCO	Policy makers
25.	2018	na	1	Wales	Europe	Digital capability frame-work for healthcare in Wales pilot	Education Wales	Organisations and individuals
26.	2018	na	1	Global	Global	Digital Literacy Global Framework (DLGF)	UNESCO	Policy makers, researchers. Teachers/trainers
27.	2018	na	1	USA	North America	Northstar Digital Literacy standards	Literacy Minnesota	individual and organisations
28,	2018	na	1	South Africa	Africa	Professional Development Framework for Digital Learning	Department of Basic Education	Individuals and organisations

c	First pub-lished	Year latest	v	Location	Continent	Title	Author	Target audience
29.	2019	na	1	Scotland	Europe	21st Century Plus	DHI	organisations and individuals
30.	2019	na	1	Canada.	North America	Digital Health Canada Competency Requirements	Digital Health Canada	Health Informatics Professionals
31.	2019	na	1	Australia	Australia and Oce-ania	Skilling the Australian Workforce for the Digital Economy - The Australian Work-force Digital Skills Framework	NCVER	Government and stakeholders
32.	2019	na	1	EU	Europe	Common Framework of Reference for Intercultural Digital Literacies (CFRIDiL)	EUMade4LL, Erasmus+ (European Commission fund)	Education/training; individuals and organisations/research
33.	2019	na	1	UK	Europe	National standards for essential digital skills	UK Government (De-partment for Educa-tion)	awarding organisations in devel-oping new essential digital skill qualifications
34.	2019	na	1	Global	Global	DQ (Digital Intelligence) Global Standard on Digital Literacy, Digital Skills, and Digital Readiness	DQ Institute	Individuals and organisations
35.	2019	na	1	Canada	North America	Digital Competency Frame-work	Government of Quebec	Citizens of Quebec
36.	2019	na	1	USA	North America	Seattle Digital Equity Initi-ative's (SDEI) Digital Skills Framework	Seattle Digital Equity Initiative (SDEI)	individual and organisations
37.	2020	na	1	EU	Europe	EFT READY Model	European Training Foundation	Training/training providers and curriculum developers
38.	2020	na	1	Global	Global	Health Information Tech-nology Competencies (HITCOMP) Tool and Repository	European Commission	health and social care work-force and education and policy pro-viders

c	First pub-lished	Year latest	v	Location	Continent	Title	Author	Target audience
39.	2020	na	0	Northern Ireland	Europe	HSC Digital Capability Framework	Digital Health & Care Northern Ireland/ NI Government	health and social care work-force
40.	2020	na	1	England	Europe	Allied Health Professionals (AHP) Digital Competency Framework	Topol Digital Health Fellowship/UK Govern-ment/Health EducatioN England	UK allied health professionals from band 3 to band 0
41.	2020	na	1	England	Europe	Digital Capabilities State-ment for Social Work Practice	NHS Digital and Health Education England	social workers/organisations
42.	2020	na	1	England	Europe	Psychological Practitioners Digital Competence Frame-work	UK Government/ Health Education Eng-land	UK psychologists and psy-cho-logical practitioner
43.	2020	na	1	Australia	Australia and Oce-ania	Digital Literacy Skills Framework	Australian Government	Australian citizens
44.	2020	na	1	Spain (partner-ship targeting Latin America, Carribean, Af-rica and Asia)	South America	The Global Framework for Educational Competence in the Digital Age	Profuturo	Teachers and trainers
45.	2021	na	1	USA	North America	The Maryland Department of Labor/Adult Education's Digital Literacy Framework for Adult Learners	The Maryland Depart-ment of La-bor, Adult Education	individual and organisations
46.	2021	na	1	Australia	Australia and Oce-ania	Capability Framework in Digital Health in Medicine	Australian Medical Council	Medical education providers
47.	2021	na	1	UK	Europe	Core Competency Frame-work for Clinical Informa-ticians (FCI Competency Frame-work)	Faculty of Clinical Infor-matics	individuals - clinical informa-ti-cians

c	First pub-lished	Year latest	v	Location	Continent	Title	Author	Target audience
48.	2021	na	1	Australia	Australia and Oce-ania	Digital health capability framework for allied health professionals	Victoria State Govern-ment	Allied Health Professionals, Man-gers and employers, Educators, Tertiary education pro-viders
49.	2021	na	1	England	Europe	Digital Capabilities for the Pharmacy Workforce	UK Government/ Health Education Eng-land	pharmacy workforce
50.	2021	na	1	Republic of Ireland	Europe	Digital Health Capability Framework	Health and Safety Executive: Office of the Nursing & Midwifery Ser-vices Director	Irish Nursing and Midwifery workforce
51.	2021	na	1	Indonesia	Asia	Indonesian National Digital Literacy Framework	Bahasa, Indonesia	individuals and organisations
52.	2021	na	1	EU	Europe	SELFIE for Teachers	European Commission	Teachers/trainers
53.	2022	na	1	New Zealand	Australia and Oce-ania	Digital Inclusion Outcomes Framework	New Zealand Govern-ment	New Zealand Citizens
54.	2022	na	1	Global	Global	Microsoft Digital Literacy Curriculum	Microsoft	Individuals and organisations
55.	2022	na	0	England	Europe	Digital Skills Framework	Digital Social Care (in partnership with the NHS Transformation Directorate)	adults in social care
56.	2022	na	1	England	Europe	National Competency Framework for Data Profes-sionals in Health and Care	NHS England and gov-ernment	organisations and individuals
57.	2022	na	1	Australia	Australia and Oce-ania	Australian Health In-formatics Competency Framework	Australasian Institute of Digital Health	Health Informatics Profession-als

Appendix 2

Table 10. Chronological list of the interrelated digital skills frameworks depicted in Figure 3 and Figure 4.

c	Year	Title	Location	Author	Audience	Document Link
1.	2015	Building digital capabilities: the six elements defined	UK	Jisc	General workforce	https://repository.jisc.ac.uk/6611/1/JFL0066F_DIGIGAP_MOD_IND_FRAME.PDF
2.	2018	A Health and Care Digital Capabilities Framework	UK	NHS England	Healthcare workforce	https://www.hee.nhs.uk/sites/default/files/documents/Digital%20Literacy%20Capability%20Framework%202018.pdf
3.	2018	RECOMMENDATIONS on A Common Framework for Mapping Health Professionals' eHealth Competencies	EU	Carrasqueiro et al., European Commission	Healthcare informatics	https://ec.europa.eu/research/participants/documents/downloadPub-lic?documentIds=080166e5bc2cac91&appId=PPGMS
4.	2018	An eHealth Capabilities Framework for Graduates and Health Professionals: Mixed-Methods Study	Intl	Brunner et al.	Healthcare workforce education (university level)	https://www.jmir.org/2018/5/e10229/
5.	2020	HITComp	Intl (EU and USA)	EU-US-Healthwork (Workforce Development Group) –	Healthcare workforce	http://hitcomp.org/competencies/
6.	2020	National Nursing and Midwifery Digital Health Capability Framework	Australia	Australian Digital Health Agency	Nursing and midwifery	https://www.digitalhealth.gov.au/sites/default/files/2020-11/National_Nursing_and_Midwifery_Digital_Health_Capability_Framework_publication.pdf
7.	2021	Digital capabilities for the pharmacy workforce	UK	NHS Health Education England	Pharmacists	https://www.hee.nhs.uk/sites/default/files/Supporting%20Dig-ital%20Literacy%20in%20the%20Pharmacy%20Workforce%20-%20June%202021.pdf
8.	2021	Development of a digital competency framework for UK Allied Health Professionals—2020 Topol Digital Health Fel-lowship.	UK	NHS England	Allied Health Profes-sionals	https://allcatsrgrey.org.uk/wp/wpfb-file/development-of-a-digital-competency-framework-for-uk-ahps-pdf/
9.	2021	Digital health capability framework for allied health professionals	Australia	Victoria State Government	Allied Health Profes-sionals	https://www.health.vic.gov.au/sites/default/files/2021-12/digital-health-capability-framework-for-allied-health-professionals.pdf

c	Year	Title	Location	Author	Audience	Document Link
10.	2021	Australian Digital Health Agency and the Australian Medical Council: Capability Framework in Digital Health in Medicine	Australia	Australian Digital Health Agency & Aus-tralian Medical Council	Healthcare informatics in medicine	https://www.amc.org.au/wp-content/up-loads/2021/07/NEWSEST-Digital-Health-in-Medi-cine-Capability-Framework-FINAL-26-July-2021.pdf
11.	2021	All-Ireland Nursing & Midwifery Digital Health Capability Framework.	Ireland &NI	Office of Nurs-ing and Mid-wifery Services Director & Northern Ire-land Practice and Edu-cation Council for Nursing and Mid-wifery.	Nurses and midwives	https://healthservice.hse.ie/filelibrary/onmsd/all-ireland-nursing-midwifery-digital-health-capabil-ity-framework.pdf
12.	2022	A Digital Capability Framework for Health-care (Demo Version)	UK	Ballantyne (Wales)	Healthcare workforce	https://www.linkedin.com/pulse/digital-capabili-ty-framework-healthcare-demo-version-lee-d-bal-lantyne/
13.	2022	All-Ireland Digital Capability Framework for Health and Social Care	Ireland & NI	Health & Social Care (HSC)	Health and social care workforce	https://www.health-ni.gov.uk/sites/default/files/publications/health/doh-all-ireland-digital-capabili-ty-framework.pdf
14.	2023	Artificial Intelligence (AI) and Digital Healthcare Technologies Capability Framework	UK	NHS England	AI informatics work-force in healthcare	https://digital-transformation.hee.nhs.uk/build-ing-a-digital-workforce/dart-ed/horizon-scanning/ai-and-digital-healthcare-technologies/frame-work-structure
15.	2023	Digital Health Competency Standards and Requirements for Undergraduate Nursing and Midwifery Education Programme (First Edition)	Ireland & NI	Nursing and Mid-wifery Board of Ire-land (NMBI)	Nursing and midwifery undergraduate educa-tion	https://www.nmbi.ie/NMBI/media/NMBI/Dig-ital-Health-Competency-Standards-and-Require-ments-First-Edition.pdf?ext=.pdf
16.	2023	Digital health competencies for the gener-ation of physicians	Australia	Scott et al. (Aus-tralia Health Edu-ca-tion)	Doctors	https://onlinelibrary.wiley.com/doi/10.1111/imj.16122

Appendix 3

Lists of the 27 frameworks included in the final analyses (targeting frontline healthcare staff, and published between 2018 and 2023). They are split across tables depicting capability, competency, and literacy frameworks.

Table 11. Chronological list of the interrelated digital skills frameworks depicted in Figure 3 and Figure 4.

c	Year	Title	Location	Author	Audience	Document Link
1.	2018	A Health and Care Digital Capabilities Framework.	UK	Health Education England	Healthcare professionals	https://www.rcn.org.uk/-/media/royal-college-of-nursing/documents/clinical-topics/a-health-and-care-digital-capabilities-frame-work.pdf?la=en&hash=52C50756A9B0EF-5F09A83EDB33EC286A62579847
2.	2020	National Nursing and Midwifery Digital Health Capability Frame-work.	Australia	Australian Digital Health Agency & Australasian Institute of Digi-tal Health.	Nurses and midwives	https://www.digitalhealth.gov.au/sites/default/files/2020-11/National_Nursing_and_Midwifery_Digital_Health_Capability_Framework_publication.pdf
3.	2021	Digital health capability framework for allied health professionals.	Australia	Victoria State Government De-partment of Health.	Allied Health Professionals (AHPs)	https://www.health.vic.gov.au/digital-health/the-digital-health-capability-framework-for-allied-health-professionals
4.	2021	All-Ireland Nursing & Midwifery Digital Health Capability Frame-work.	Ireland and Northern Ire-land	Office of Nursing and Midwife-ry Services Director & Northern Ireland Practice and Education Council for Nursing and Mid-wifery.	Nurses and mid-wives	https://healthservice.hse.ie/filelibrary/onmsd/all-ireland-nursing-midwifery-digital-health-capability-framework.pdf
5.	2021	Digital Capabilities for the Pharmacy Workforce	England, UK	NHS Health Education England. (2021b).	Pharmacy work-force	https://www.hee.nhs.uk/sites/default/files/Supporting%20Digi-tal%20Literacy%20in%20the%20Pharmacy%20Workforce%20-%20June%202021.pdf
6.	2022	All-Ireland Digital capability Framework for Health and Social Care.	Ireland and Northern Ire-land	Health and Social Care	Health and Social care staff	https://www.health-ni.gov.uk/publications/all-ireland-digital-capability-framework
7.	2022	Digital capability framework for healthcare in Wales (pilot).	Wales, UK	Health Education and Improvement Wales. (We also refer to the Demo Versin of this framework by Ballantyne, L.D 2022 – link below)	Healthcare professionals	https://heiw.nhs.wales/news/digital-capability-framework-for-healthcare-in-wales-pilot/ Link to Ballantyne demo version: https://rise.articulate.com/share/Tz2Nw3VQlvNCVuHvqR-S6ksCzjHju9omS#/
8.	2023	AI and Digital Healthcare Tech-nologies.	UK	Health Education England	Healthcare profession-als	https://digital-transformation.hee.nhs.uk/building-a-digital-workforce/dart-ed/horizon-scanning/ai-and-digital-healthcare-technologies

Table 12. Digital Competency Frameworks

c	Year	Title	Location	Author	Audience	Document Link
1.	2018	Recommendations on A Com-mon Framework for Mapping Health Profes-sionals' eHealth Competencies. Joint Action to support the eHealth Network. [JASEHN eHealth Competence model]	European Union (EU)	Carrasqueiro, S. (part of Joint Action to support the eHealth Network)	Healthcare professionals	https://web.archive.org/web/20201211034628/https://jasehn.eu/wordpress/wp-con-tent/uploads/2018/07/JAseHN_D7.1.3_RECOMMENDA-TIONS_common_Frame-work_mapping_health_profession....pdf
2.	2020	Health Information Technology Competencies (HITComp)	Inter-na-tional [mainly the EU and USA]	EU*US eHealth Work Pro-ject & Omni Micro Systems.	Healthcare professionals	http://hitcomp.org/competencies/
3.	2020	Digital Competencies for Psy-chological Professions.	UK	Digital Healthcare Sub-Com-mittee for Division of Clinical Psychology, British Psychological Society.	Clinical Psy-chologists	https://digitalhealthskills.com/digitalcompetencies/
4.	2021	Development of a digital competency framework for UK Allied Health Profession-als—2020 Topol Digital Health Fel-lowship.	UK	NHS Health Education England	Allied Health Professionals (AHPs)	https://allcatsrgrey.org.uk/wp/wpfb-file/develop-ment-of-a-digital-competency-framework-for-uk-ahps-pdf/
5.	2021a	Digital competency frame-work for DigArt Therapy (Art therapy, Dramatherapy, Music therapy)	UK	NHS Health Education England	Art thera-pists, drama therapists, mu-sic thera-pists (AHPs)	https://healtheducationengland.sharepoint.com/:w:/g/Comms/Digital/EZQTAjrJsIZCl-qJ45h1AH4BnwakiIMHVK-DinxUvtq9eyA?e=CeHtYm
6.	2021b	Digital competency framework for Diagnostic Radiography	UK	NHS Health Education England	Diagnostic radiogra-phers (AHPs)	https://healtheducationengland.sharepoint.com/:w:/g/Comms/Digital/EQObsU_EUZpPgejczMz9cZcBmmCwap-oFgTxoqfh-vUHWBQ?e=GHFVQX
7.	2021c	Digital competency framework for Dietetics	UK	NHS Health Education England	Dietitians (AHPs)	https://healtheducationengland.sharepoint.com/:w:/g/Comms/Digital/EQrdQ6B1NqBPqfolB50lVUQB_cb-viLq5UPTRXtFHJzuNiA?e=dGleQz&wdLOR=cE-D3EF5D8-AAD5-4F9A-9B50-F26EDA5383FD

c	Year	Title	Location	Author	Audience	Document Link
8.	2021d	Digital competency framework for Occupational Therapy	UK	NHS Health Education England	Occupational therapists (AHPs)	https://healtheducationengland.sharepoint.com/:w:/g/Comms/Digital/EWoqBiot2KNNh9lM9KqM5CsBKHqyD1x-Idt8PNKngtpuqkQ?e=nFRbvv&wdLOR=c6DA84C9C-BAF4-4CAB-BB8E-8A3F4E4EC156
9.	2021e	Digital competency framework for Operating Department Practitioners	UK	NHS Health Education England	Operating depart-ment practitioners (AHPs)	https://healtheducationengland.sharepoint.com/:w:/g/Comms/Digital/EVcAb3uv_EhLg2lOVRhthwwB2FcKAF9G-swFBrg5-4nFe1Q?e=FKTlio&wdLOR=cCF4FBAF0-F01A-44AA-9E33-981715730932
10.	2021f	Digital competency framework for Orthoptists	UK	NHS Health Education England	Orthoptists (AHPs)	https://healtheducationengland.sharepoint.com/:w:/g/Comms/Digital/EWGA-9jIPP1LsBg7F9sQSQM-B3ROCgX-n1R9MnnEg_nQVMA?e=HkcKZL
11.	2021g	Digital competency framework for Orthotists/Prosthetists	UK	NHS Health Education England	Ortho-tists/ Prosthetists (AHPs)	https://healtheducationengland.sharepoint.com/:w:/g/Comms/Digital/EWGA-9jIPP1LsBg7F9sQSQM-B3ROCgX-n1R9MnnEg_nQVMA?e=HkcKZL&wdLOR=c-0CB09EA2-0BDB-4E67-9F3F-2FB974421D04
12.	2021h	Digital competency framework for Osteopathy	UK	NHS Health Education England	Osteopa-thists (AHPs)	https://healtheducationengland.sharepoint.com/:w:/g/Comms/Digital/ESi2XOL9O1ZBqjePZzE0A_MBoyLFYQQr-NU4V6fIPkBhi6Q?e=hohocz&wdLOR=cB7007D31-D842-4DB7-BA47-8616E66A4031
13.	2021i	Digital competency framework for Paramedics	UK	NHS Health Education England	Paramedics (AHPs)	https://healtheducationengland.sharepoint.com/:w:/g/Comms/Digital/EV_p7yzl6VNCvZ6AECCJ_8sB1FmwkyElh-wEx00I8zi6AUQ?e=jydJ2m&wdLOR=c0BBDCB70-7432-413F-AA1F-73A32E617EBE
14.	2021j	Digital competency framework for Physiotherapists	UK	NHS Health Education England	Physiothera-pists (AHPs)	https://healtheducationengland.sharepoint.com/:w:/g/Comms/Digital/EfZLKPpCiDpOocqsrubrS3YBRltzOrRO-hg1aylKalr2pag?e=x6OWVD&wdLOR=c6A5E1F9C-63B4-4552-AD0C-904277B2735E
15.	2021k	Digital competency framework for Podiatry/Chiropody	UK	NHS Health Education England	Podia-trists/ Chiropodists (AHPs)	https://healtheducationengland.sharepoint.com/:w:/g/Comms/Digital/ES1cTGk5kUxPivfMNPT460QBr3INdu4f-cZyXEfpatIgCpg?e=Ze5ize&wdLOR=c11EFF0FF-9E37-4DFE-944F-2593767B6115

c	Year	Title	Location	Author	Audience	Document Link
8.	2021l	Digital competency frame-work for Speech and Language Therapy	UK	NHS Health Education England	Speech and Language Therapists (AHPs)	https://healtheducationengland.sharepoint.com/:w:/g/Comms/Digital/EUgfTVjhMsZGsg1HOk-jkRQ4B7WFq-qbp-Gx21vk-1Kcvmw?e=GS8psR&wdLOR=c49BCF7C2-DF96-4B58-A087-890D16F4E9BA
9.	2021m	Digital competency framework for Therapeutic Radiography	UK	NHS Health Education England	Therapeutic Radiogra-phers (AHPs)	https://healtheducationengland.sharepoint.com/:w:/g/Comms/Digital/EenmFe-pa-VO-sY3QKS9BSdABlUJrJnQXKm21gAtr27IaUw?e=qd-5qE2&wdLOR=c48CB408A-95BC-463D-A735-5F85761B5991
10.	2023	Digital Health Leadership skills frame-work	UK	Health Education England.	Digital leaders in healthcare work-force	https://digital-transformation.hee.nhs.uk/digital-academy/programmes/digital-health-leadership-programme/digital-health-leadership-skills-framework

Table 13. Digital Literacy Frameworks

c	Year	Title	Location	Author	Audience	Document Link
1.	2023	Data and Digital Literacy for Psychiatrists.	UK	Bachlani, A., Runciman, R., Dave, S., Bradley, P., Reza, H., Rahim, A., Vinjamuri, I., Moore, S., & Tracy, D. (Royal College of Psychiatrists).	Psychiatrists	https://www.rcpsych.ac.uk/training/curricula-and-guidance/Digital-Literacy-Framework