National Digital Health Workforce and Education Roadmap

September 2020

Australian Government

Australian Digital Health Agency

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Foreword

This *National Digital Health Workforce and Education Roadmap* builds upon *Australia's National Digital Health Strategy – Safe, Seamless and Secure* and the associated Framework for Action (FFA). The roadmap seeks to provide a basis for understanding the digital capability requirements of all those involved in the healthcare system including the health workforce, volunteers and health consumers. The roadmap also acknowledges how the application of digital technologies in health are impacting the workforce and associated education requirements and anticipates how these technologies are likely to impact the workforce and education requirements in the medium term, including emerging technologies. It is intended to offer a common foundation for the work that will be performed by a broad range of health system participants to address the challenges and opportunities presented by digital health in all its guises.

> *"A workforce confidently using digital health technologies to deliver health and care will be required to address the technology adoption challenge … and embrace the changes and opportunities created by digital health innovation."*
>
> *Australian Digital Health Agency, 2016*[1]

The benefits of digital health are significant and compelling. These include improved access to information to support safer clinical decision making and fewer adverse drug events; improved care coordination and reduced hospital admissions; reduced duplication of diagnostic investigations; and improved health service planning that anticipates demand for healthcare services. Importantly, empowering people with access to their own health information enables a person-centred model of care. Used effectively digital health can save lives, as well as improve the health and wellbeing of all Australians. Further, these technologies can support a sustainable health system that delivers safe, high-quality, and effective health services.

Significant investments to modernise health service delivery are being made. All states and territories, and many other healthcare providers, have prioritised digital health to improve service delivery and health outcomes. Entrepreneurs and developers across the country are investing in innovative ways to provide health services, including new tools and improved use of available data. Achieving the benefits of these investments depends on a workforce with the requisite digital literacy and educative opportunities. Consumers of healthcare services also need support in learning how to take advantage of digital health.

Australians are right to be proud of their health system. However, the system faces serious challenges including financial constraints and rising demand for services. In this context it is imperative to leverage technology and innovation to support high-quality and sustainable healthcare for all. Indeed, the arrival of the novel coronavirus (SARS-CoV-2) causing the 'COVID-19' pandemic, has resulted in a significant uplift in technology adoption – specifically telehealth, as new temporary Medicare Benefits Scheme (MBS) telehealth services[2] have been created in response to the pandemic[3]. In the face of the surge in COVID-19, clinicians and health systems worldwide have been "racing to adopt virtualised treatment approaches that obviate the need for physical meetings between patients and health providers[4]". There will be important lessons learnt around this uptake that can and will influence technology adoption going forward and will have a lasting impact on the health workforce.

Executive summary

> *"While few industries have the potential to be changed so profoundly by digital technology as healthcare, the challenges facing innovators should not be underestimated."*
>
> *World Economic Forum, 2016*[5]

The health leaders of today are faced with opportunities and challenges from an array of emerging technologies. These technologies are expected to profoundly change the way healthcare is delivered, and impact traditional approaches to health occupations, tasks and functions. A confident and capable health workforce is required to realise the benefits of digital health. Indeed, many technologies are already impacting traditional approaches to the way healthcare is delivered and these opportunities and challenges need to be better understood to ensure an appropriately skilled and capable workforce can support them.

The purpose of the roadmap

The development of the roadmap reflects the reality that the education and training provided to the current and future health workforce must be re-shaped in order to meet the existing and emerging digital requirements and that a partnership with the education sector is essential. It also recognises that, despite the considerable benefits that are flowing from the digital transformation of healthcare systems around the world – and will continue to do so, people will remain the most valuable asset.

To understand emerging requirements effectively, in addition to the requirements that have emerged to date, the impacts of digital health on the entire health workforce, including volunteers and consumers, need to be better understood. This understanding must reflect differences across metropolitan, regional, rural and remote Australia, from hospitals to primary care and aged care settings, and among the full range of healthcare occupations, as well as consumers and healthcare system administrators.

The roadmap provides a framework for understanding the digital capability requirements. The roadmap also anticipates how the application of digital health is likely to impact the workforce and education requirements in the short to medium term. The roadmap sets out a vision for how the workforce can be transformed over the next decade and beyond to realise the benefits promised by digital health.

The roadmap as such is a strategy. It does not contemplate in detail the roles and responsibilities, timeframes and targets, which will be subject to the development of a National Digital Health Capability Action Plan (hereafter Capability Action Plan or CAP). This will be developed in close concert with all partners, including government, universities and education providers, accreditors, and clinical and consumer peaks. This process will ensure the CAP appropriately represents sector priorities, can harmonise the work already occurring both nationally and within jurisdictions, and has

funding sources identified. It will also ensure that roles and responsibilities are clear, and organisations are supportive of the approach. This is planned to occur following finalisation of the roadmap and is a critical next step to ensure implementation of the roadmap and realisation of the benefits that will flow to Australia's health workforce.

Intended audience

The intended audience for this document spans organisations and individuals across the healthcare landscape, including all Australian jurisdictions, universities and education providers, clinical and consumer peaks, researchers, industry, clinicians and other health workers, consumers and carers. Any stakeholder with an interest in ensuring the health workforce is better equipped and more confident in the use of digital health would benefit from reading this document.

Development principles

The roadmap is based on a key set of underpinning principles developed through consultation with education, health and consumer stakeholders. These principles are:

- National alignment, collaboration and accountability;
- Flexibility to respond to diverse digital technologies, digital maturity variations and operational environments;
- Leveraging partnerships to drive innovation;
- Delivery of equity of access to healthcare for all Australians, acknowledging the requirement for digital inclusion;
- Ethical use of data and information;
- Responsiveness to government and community priorities; and
- Focus on tangible actions and measurable objectives.

Setting the scene

Globally, focus on digital health remains on the role of existing and emerging technologies rather than the capabilities required for the workforce to use them effectively. This is despite the significant health workforce impacts that are already being experienced, and those that are being anticipated. Indeed, there will be important learnings following the significant uplift in technology adoption – specifically telehealth, due to COVID-19, that can and will influence technology adoption going forward and the associated impact on the health workforce.

Digital health has evolved from an eHealth orientation to encapsulate emerging technologies including artificial intelligence, genomics and advanced robotics.

The United Kingdom has released the greatest number of health workforce publications in this area – most notably the *Topol Review*[6] in 2019. Globally, the European Union, the United Kingdom, the United States and countries such as Canada and Israel are also leaders in digital health. Despite this leadership in digital health, very few health-specific digital capability and digital literacy frameworks have been developed internationally.

Definition of the health workforce

For the purpose of this roadmap the term 'health workforce' is defined to encompass 'all individuals who deliver or assist in the delivery of health services or support the operation of health care facilities'. This definition includes health care professionals, such as nurses, midwives, doctors, aboriginal health workers, allied health providers, and all other workers in the health system such as administrative assistants, health technology professionals and wardspersons. This definition encompasses the public and private system, and the many environments it traverses – metropolitan, regional, rural and remote. It encompasses the 'workforce in health', and from herein will be referred as the 'health workforce'.

The education requirements of consumers, patients, carers and volunteers are also considered within this roadmap.

While there are some innovative examples in Australia, the digital health capability of the workforce is still emerging as an area of focus in the health, education and training sectors. Pockets of innovation include the Certified Health Informatician Australasia (CHIA) certification program on digital health, the Australasian Institute of Digital Health (AIDH) Fellowship by Training Program (FTP) being run in concert with Macquarie University's Centre for Research Excellence, and Queensland's Digital Academy. There is also the Digital Health Cooperative Research Centre (Digital Health CRC), which is a $230M 7-year program of work funded by industry and the federal government to create the digital health future. The program was funded in 2018 and has over 80 partners which include state and federal jurisdictions, primary health networks (PHNs), private and public services, technology businesses, payers, regulators, peak bodies and 16 universities. More information is contained at Case study: Digital Health Cooperative Research Centre.

However, Australia's 'Health Information Workforce Census' found 71.8% of respondents do not have a health information credential and 44.5% do not belong to a professional or industry association. In this context, a health information worker refers to an employee or volunteer in a role associated with the management of health data, information or knowledge[7]. There are a number of barriers to digital health education and innovation. These include:

- 'Curriculum crowding' of undergraduate curricula;
- Limited demand for digital health-focused subjects according to education and training providers;
- A need for contemporary content that meets diverse industry needs;
- Resistance to changes to scope of practice in certain health professions; and
- Investment capacity, particularly for small private health employers.

These factors are compounded by a poor understanding of the value that the health information workforce can contribute to solving the sector's most pressing issues.

There are also challenges resulting from the different levels of digital maturity across the health sector, and this includes the wide variation in digital maturity across Australia's jurisdictions. This was emphasised in the most recent 'Australian Digital Inclusion Index Report' (2019), which noted that "the benefits of the digital economy cannot be shared when some members of the community are still facing real barriers to online participation[8]". This is in sharpest focus for Tasmania. It is unsurprising that there persists a digital inclusion gap between urban and rural environments across Australia, (the "capital–country gap") and while it is closing in some jurisdictions, this gap widened for Tasmania in 2019. This gap

extends to the health context where adoption of electronic health and medical records in hospitals and health services, and in community and private practice in Tasmania is challenged. There is an opportunity to leverage work undertaken in digitally mature jurisdictions for the benefit of others. The benefits of the digital economy should be shared by all Australians.

Consequently, each health worker, employer or education and training provider begins their journey at a different point. Development of digital health literacy and capability should follow a stepped approach which supports broad-based advancement.

Consumer views about digital health are generally positive and support digital adoption, and this is highlighted most sharply in Australia's National Digital Health Strategy[9]. However, they do not believe it will replace the need for face-to-face contact in healthcare. People with complex chronic health conditions who visit multiple health professionals are most open to digital adoption. Digital literacy varies among consumer groups, and a focus on health equality is needed.

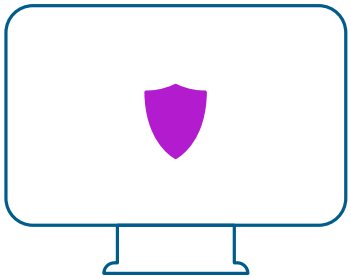
Experience in Australia and internationally indicates that there is a 'tipping point' for digital health adoption at which the benefits of investments in digital health solutions are unlocked. Directionally, achievement of benefits is positively correlated with the majority of intended users adopting a digital health solution. Below this level of adoption, the anticipated benefits of a digital health solution may not be realised or may be diluted.

Achieving this tipping point will require technical capabilities and understanding why changes to practices should be adopted. This will require capability development to provide the health workforce with both foundational digital health literacy and solution-specific knowledge to use digital health solutions effectively, noting that investments in digital health literacy are already taking place. It will also require interventions to drive changes in behaviour that increase the adoption of digital health solutions.

The road ahead: horizons of workforce and education change

This roadmap uses a horizon-based framework to explore the workforce and education changes required to support the adoption of digital health. Horizons divide workforce and education impacts into three broad categories, each with distinct workforce and education implications. Horizons are differentiated by the nature of the changes taking place. The first horizon focuses on the use of core 'electronic systems of record' (the authoritative data source for a given piece of information) and digital capability uplift; the second on the application of digital health in specific areas of practice; and the third on driving system-wide benefits. Work to address each horizon should progress in parallel.

The projected timeframes have been informed by the literature and through consultation and are intended as a guide only. Workforce and education changes to support each of these shifts are already emerging; for example, the transformational reforms contemplated in Horizon 3 are already underway in some capacity including 'consumers as partners' and care outside of hospital settings. However, the expectation is that these reforms are operating at scale.



Horizon 1:
Embedding safe, ethical and effective use of systems of record [now to 2022]

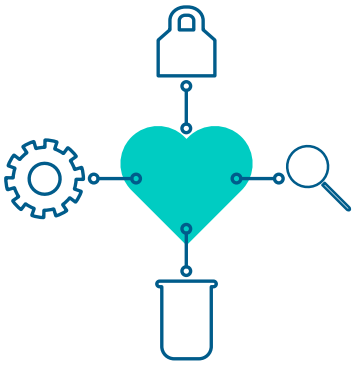
The first horizon focuses on embedding the current digital health foundations, and extending the safe, ethical and effective use of information systems. In its purest form, this is the transition of paper-based practices and systems across healthcare settings to electronic systems of record. Key technologies include the widespread adoption of electronic medical records (EMRs), electronic health records (EHRs), electronic medication management (EMM) and telehealth – noting that there has been an unprecedented uptake in the adoption of telehealth during the COVID-19 pandemic[10]. This is consistent with other Australian state and territory digital health strategies which focus on establishing digital health foundations. These changes are expected to support the delivery of benefits to both patients and the health system in the following ways:

- Patients will have greater decision-making power due to increased access to information and digital health tools
- Information sharing between all relevant health organisations will improve the transparency and quality of healthcare
- Secure messaging and eReferrals will enhance the clinical workflows and the flow of information through the health system
- Avoiding duplication of diagnostic scans and pathology tests by using EMRs and EHRs will reduce costs
- Further expansion of electronic medications management will minimise adverse drug events (ADEs).

From a workforce perspective, this horizon focuses on improving the digital literacy across the health workforce. Key to this is acknowledging that there are different digital roles played by members of the health workforce – from the nurse at the bedside to cyber security experts, and everyone in between. Eight digital profiles have been created to reflect these different roles and the associated differences in digital expectations.

Education and training will be required to support the health workforce develop the capabilities required to meet these expectations, as well as broader capability development in areas such as ethics and governance, security and privacy, and change leadership.

The development of new mindsets and new skills to lead people through health system complexity and creating more adaptive cultures will challenge deeply held norms of behaviour that prevent adaptive cultures from emerging. Leaders will need to adopt new mindsets that focus on the higher purpose in healthcare and navigate entrenched mindsets that prevent new behaviours and learning from emerging. They will need new skills to mobilise diverse stakeholders to adopt new ways of working and interacting - skills such as conflict management, collaboration, leading behavioural change, systems thinking and political dynamics. These skills will be required across all three horizons.



Horizon 2: Integrating new technologies and ways of working [now to 2027]

The second horizon is focused on how the scaled adoption of emerging technologies (including artificial intelligence (AI), genomics, advanced robotics and 3D printing) will impact workforce and education requirements. New ways of working will be required to support the scaled adoption of these technologies and maximise their benefits. New roles and changes to existing roles will continue to emerge. New methods of working must be introduced in a way that supports and values the contribution of all staff within the health sector.

Horizon 2 is expected to deliver significant benefits to both patients and health professionals, including:

- Interoperability will support clinician decision-making through providing access to patients' most recent clinical information from a range of sources;
- Minimisation of duplicate data entry through streamlined information flows to increase efficiencies for frontline clinical and administrative roles;
- Variability reduction (including that resulting from human error) and improvement of semantic interoperability through reduced manual data entry and increased use of technology in health information management; and
- Improvement of diagnostic and treatment options through the scaled adoption of digital health such as AI, 3D printing, and advanced robotics.

Horizon 2 includes a glimpse into the future based on analysis of emerging technology capabilities over the next 10 years. This analysis leverages a proprietary model of how technology advances will create automation and augmentation opportunities developed by Faethm. Faethm is a platform and database that can be used to predict technologies expected to impact the workforce based on the human abilities they disrupt or enhance. This has been applied to health workforce data from the Australian Bureau of Statistics 2016 Census data to identify the most promising classes of technologies across different segments of the health sector. See Faethm: glimpse into the future for more information.

Workforce and education implications stemming from these changes are highly technology- and role-specific. Professional and specialist bodies will play a role in anticipating and responding to the technologies most relevant to their areas of focus. Workplace-specific education will play a critical role in driving the new ways of working necessary to achieve the benefits of new technologies. Transformational and situational leadership capabilities will also be required to support the identification and successful delivery of digital health programs that will cause significant disruption at the enterprise level.

Horizon 3: Digital health transformation [now to beyond 2027]

Planning for current education and training needs must be balanced with consideration for longer-term requirements. Education and training will need to be contemporary and promote the mindsets and behaviours needed for a digital future. In Horizon 3 transformational reforms are considered, including value-based healthcare, personalised medicine, consumers as partners, and care outside of hospital settings.

Digital health adoption will drive the following transformations in Australia's health system:

- Organisations better connected to analyse information, and plan and respond to population health demand in a proactive manner. This includes a system-wide collective and consistent approach to the management of security, privacy and safe handling of data;
- Clinicians and consumers leveraging digital health to partner in the management of their health, and reduce the cost burden associated with chronic disease;
- Better patient outcomes, experiences and improvement in the effectiveness of healthcare spending resulting from value-based healthcare, personalised medicine, and healthcare in the home; and
- Improved risk stratification of health conditions and more effective prioritisation of care through real-time data and predictive analytics.

Digital capabilities established in Horizon 1 and the new technologies and roles that emerge in Horizon 2 will underpin these transformations. Given the size and scale of the changes anticipated, transformational leadership capabilities at the executive, board and clinical and non-clinical leadership levels will be key to realisation of Horizon 3 benefits.

Digital profiles

In undertaking the development of the roadmap, a series of digital role profiles have been introduced to guide organisations and individuals to understand the different requirements of the health workforce depending on the role the individual plays in the design, development, implementation and adoption of digital technologies.

The purpose of the Digital Profiles Framework is to articulate the expectations of the health workforce as a result of the adoption of digital health. It is designed to provide clarity for key education and health partners who will develop curricula, training and resources to assist the workforce, and to empower health workers and consumers to recognise and grow their digital capability. Further detail on the digital profiles is contained in the section entitled 'Key elements of digital profiles'.

Views of the digital literacy capability uplift interventions that will be required for each digital profile are summarised in Figure 9 and Figure 10.

Table 1: Digital profiles and expectations

Enablers and opportunities

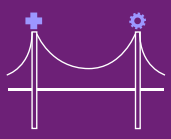
 **Patient, Consumer and Carer**	The Patient, Consumer and Carer profile expectations include maintaining health information, protecting the security and privacy of information, and adopting and advocating for new technologies that help manage their health.	• Digital Partner in My Health • The Digital Adopter and Lifelong Learner • The Quality Record Verifier • The Security and Privacy Enforcer • The Health Reformer
 **Frontline Clinical**	The Frontline Clinical profile expectations include lifelong learning, adoption of digital technologies, understanding security and privacy, reliable and accurate record keeping, ensuring clinical safety with digital technologies, and advocating for consumer use of technology to empower them.	• The Digital Adopter and Lifelong Learner • The Information Analyser • The Quality Record Keeper • The Security and Privacy Protector • The Consumer Advocate • The Clinical Specialist
 **Digital Champion**	The Digital Champion profile expectations include being a digital teacher and champion locally for a particular technology or system. The Digital Champion role may change depending on the digital technology and setting. Key to this role is the early digital adoption and change champion functions they play in the workplace.	• The Technical Teacher • The Digital Change Champion • The Early Adopter and Lifelong Learner • The Troubleshooter • The Health Reformer • The Quality Gatekeeper • The Ethics, Security and Privacy Champion
 **Clinical and Technology Bridging**	The Clinical and Technology Bridging profile expectations include providing advice during the design and development of new digital technologies and systems, and leveraging clinical networks for user testing and adoption. This profile represents the clinical/health informatician.	• The Clinical Designer/Specification Advisor • The Clinical Information Analyser • The Risk and Governance Enforcer • The Digital Change Champion • The User Tester • The Problem Solver • The Health Reformer and Innovator • The Quality Controller

Table 1 continued: Digital profiles and expectations

 **Technologist**	The Technologist profile includes expectations for those performing health information technology functions, including cybersecurity, programming, systems maintenance, digital design, interoperability, IT procurement, resilience and continuity planning, health information management and system testing.	• Information Integrity Enforcer • Digital Technology Designer/ Programmer • Complex Troubleshooter/Problem Solver • Interoperability Integrator • Digital Innovation Tester • Digital Security/Cyber Security Expert • Digital Program and Project Manager • Digital Technology Procurer
 **Leadership and Executive**	The Leadership and Executive profile expectations include leadership of digital transformation and deployment, risk and quality assurance, and understanding sophisticated data analytics to drive better business decisions.	• Digital Transformation Sponsor • Digital Deployment Navigator • Risk and Mitigation Custodian • Information and Data Synthesiser and Decision Maker
 **Business, Administration and Clinical Support**	The Business, Administration and Clinical Support profile expectations include learning, adoption of digital technologies, understanding security and privacy and reliable and accurate recordkeeping.	• The Digital Adopter and Lifelong Learner • The Information Analyser • The Quality Record Keeper • The Security and Privacy Protector • The Health Reformer • The Digital Change Champion • Information & Data Synthesiser & Decision Maker
 **Education and Research**	The Education and Research profile identifies expectations including lifelong learning, translational research, evidence based review, and health reform and innovation. It also addresses expectations relating to education.	• The Digital Adopter and Lifelong Learner • The Ethics and Privacy Advocate • The Digital Teacher • The Information Analyser • The Digital Change Champion • The Health Reformer

Work is already underway to build digital health capabilities across the health workforce, but given the scale of what is necessary, the efforts of many committed experts in the area of digital health and workforce capability will be required. Many stakeholders will play a role in shaping the future and supporting the health workforce adopt digital possibilities.

The scale of workforce and education transformation envisaged in this roadmap is broad. This roadmap identifies several key enablers that will help unlock progress. These opportunities include:

- ***Targets and measures*** – Targets for digital health capability development and adoption, designed and agreed with principal stakeholders, will be essential to focus the activities of all health system participants. Targets and measures will be agreed, through the CAP development process, for the actions that will be critical to the Australian health system reaching the adoption tipping point.
- ***Board and executive mobilisation*** – Benefits-focused education to enhance the understanding of boards and executives across the health sector. This will create a context in which digital health workforce and education capability development is prioritised.
- ***Cultivating digital health learning cultures*** – Collaboration between employers, professional bodies and education providers can provide opportunities and incentives for curiosity and self-directed learning in the area of digital health. While the Australian Health Practitioners Regulation Authority (Ahpra) already requires under law that registered health practitioners undertake continuing professional development (CPD)[11], contemplation of digital health remains variable at best and is not mandated in most undergraduate education programs. This will support continuous learning and innovation adoption across the health sector.
- ***Shared education and resources*** – Establishment of a centralised capability to identify common needs such as frameworks to inform curricula review, and access to systems to practice digital skills. This will include commissioning production of relevant resources, managing access to resources, and tracking return on investment.
- ***Ethical frameworks*** – Building on existing work to develop a core set of digital health ethical principles covering AI and the broader set of digital technologies. This will include risk-based initiatives to develop more granular guidelines in areas where risks are greatest.
- ***Partnership and collaboration*** – Sector-wide agreement on priorities and accountabilities for driving tangible activities that deliver digital health capability uplift. Agreements should emphasise collaboration and sharing of good practices. This includes partnerships between health services, researchers and industry to accelerate the delivery of benefits and further drive innovation.

Next steps

The roadmap is the product of sector-wide collaboration aimed at supporting the achievement of the goals described within Australia's National Digital Health Strategy. It identifies the roles and requirements of consumers, healthcare providers, health informaticians, healthcare technologists, administrators and health service leaders to lift digital health capacity and capability over three-time horizons.

Work is underway in many areas; however, a coordinated approach is needed. This will require leadership, support and engagement from participants across the health and education sectors. It is critical that the pathways and roles to build the digitally capable health workforce are clearly articulated, widely understood and adopted, and aligned with sector priorities, noting the varying levels of current digital maturity across the health workforce. Specific actions and targets will be captured through the development of the Capability Action Plan (CAP). The CAP, which is key to the ongoing evolution of the health workforce, and a critical next step, will be undertaken in close collaboration with all Australian jurisdictions, university and education providers, clinical and consumer peaks and accreditation authorities. This tactical plan, which will provide a detailed cost analysis, will commence development in the financial year 2020/2021.

The change ahead is exciting. The development of the roadmap recognises that a digitally capable health workforce is central to delivering health services and outcomes, now and into the future.

1 Background

1.1 Australia's National Digital Health Strategy

Since the establishment of the Australian Digital Health Agency (the Agency) in 2016, significant work has been undertaken to further progress the digital health capability of the healthcare system across Australia, building on work already underway. The National Digital Health Strategy (the strategy) was created by the Agency and agreed by all states and territories through the Council of Australian Governments (COAG) Health Council in August 2017. It defines the National Digital Health Strategy Vision:

> *"Better health for all Australians enabled by safe, seamless, secure digital health services and technologies that provide a range of innovative, easy to use tools for both patients and providers."*
>
> *Australian Digital Health Agency, 2016*[12]

The strategy identified seven priorities[13]:

1. Health information that is available whenever and wherever it is needed;
2. Health information that can be exchanged securely;
3. High-quality data with a commonly understood meaning that can be used with confidence;
4. Better availability and access to prescriptions and medicines information;
5. Digitally enabled models of care that improve accessibility, quality, safety and efficiency;
6. A workforce confidently using digital health technologies to deliver health and care; and
7. A thriving digital health industry delivering world-class innovation.

1.2 The Framework for Action

The Agency developed a Framework for Action (the framework) in July 2018 based on extensive consultation with the community and the health system. The framework defines priority actions which support the vision, the outcomes and benefits committed to in the strategy. The framework articulates the role of participants in achieving each strategic priority. Participants' roles are based on consultation and supported by the Agency's further engagement with the digital health ecosystem.

The priority actions identified for the 'Workforce and Education' strategic priority include:

1. Supporting the workforce to **confidently use digital technologies**;
2. Development of digital health national **educational curricula** and **training materials**; and
3. Integration of digital health in **national standards** and **accreditation requirements**.

Section 5.8 explores how delivering the opportunities identified in the roadmap supports the achievement of these objectives.

1.3 Building on digital health progress

Since the agreement of the strategy and the framework, significant progress has been made to further advance the priorities identified within the strategy. Significant achievements have been made on My Health Record adoption. In June 2020 the national participation rate had reached approximately 90%, with more than 22 million records, 99% of registered pharmacies and 93% of registered GPs using My Health Record and 95% of public hospital beds registered[14]. In total more than 2.09 billion documents have been uploaded to the record, including more than 75 million clinical records and more than 143 million prescription and dispense records. There has been significant progress in connecting pathology and diagnostic imaging providers to My Health Record. Nearly all public providers are uploading and the number of private providers registering, and uploading is accelerating. There are now more than 61 million diagnostic reports in My Health Record[15].

In Australian hospitals, there has been significant growth in the use of integrated electronic medical record systems, led by significant rollouts in New South Wales and Queensland, and further expansion in Victoria. Further work is underway in South Australia with the transition from the Enterprise Patient Administration System (EPAS) project to a new EMR project, and in Western Australia, Tasmania and the Australian Capital Territory with digitised medical records. The Northern Territory is undergoing the replacement of bespoke systems under the Core Clinical Systems Renewal Project (CCSRP)[16].

1.4 An evolving definition of digital health

The definition of digital health has expanded from a narrow focus on eHealth to a wider view that encapsulates mobile health, wearable devices, AI, robotics, personalised medicine, telehealth and telemedicine, and innovative evidence-based products and services[17,18]. Importantly, the understanding of digital health today extends beyond the use of electronic storage of data, to the active use of this data to inform service design and delivery. Digital health is a broad term and its definition will continue to change as new health technologies emerge[19].

Embracing digital health provides significant opportunities to continue to drive improvements in the quality and safety of healthcare. Innovations providing timely and accurate information, and the integration of data into information systems will help drive efficiency and reduce risk. The use of advanced analytics, the Internet of Things (IoT), AI, and 'big data' will help drive population healthcare and health system design, planning and operational improvements. Innovations

stemming from fields including genomics, advanced robotics, personalised medicine and wearable devices will enable new healthcare interventions not available to clinicians, health professionals or consumers and their carers today[20], noting that these changing technologies require new legislative, policy and ethical frameworks, which will require workforce upskilling and training.

A range of digital technologies will drive the potential of digital health. Figure 1 below describes some – but not all – of the relevant and emerging technologies that are being adopted in healthcare.

Figure 1: Technologies impacting healthcare

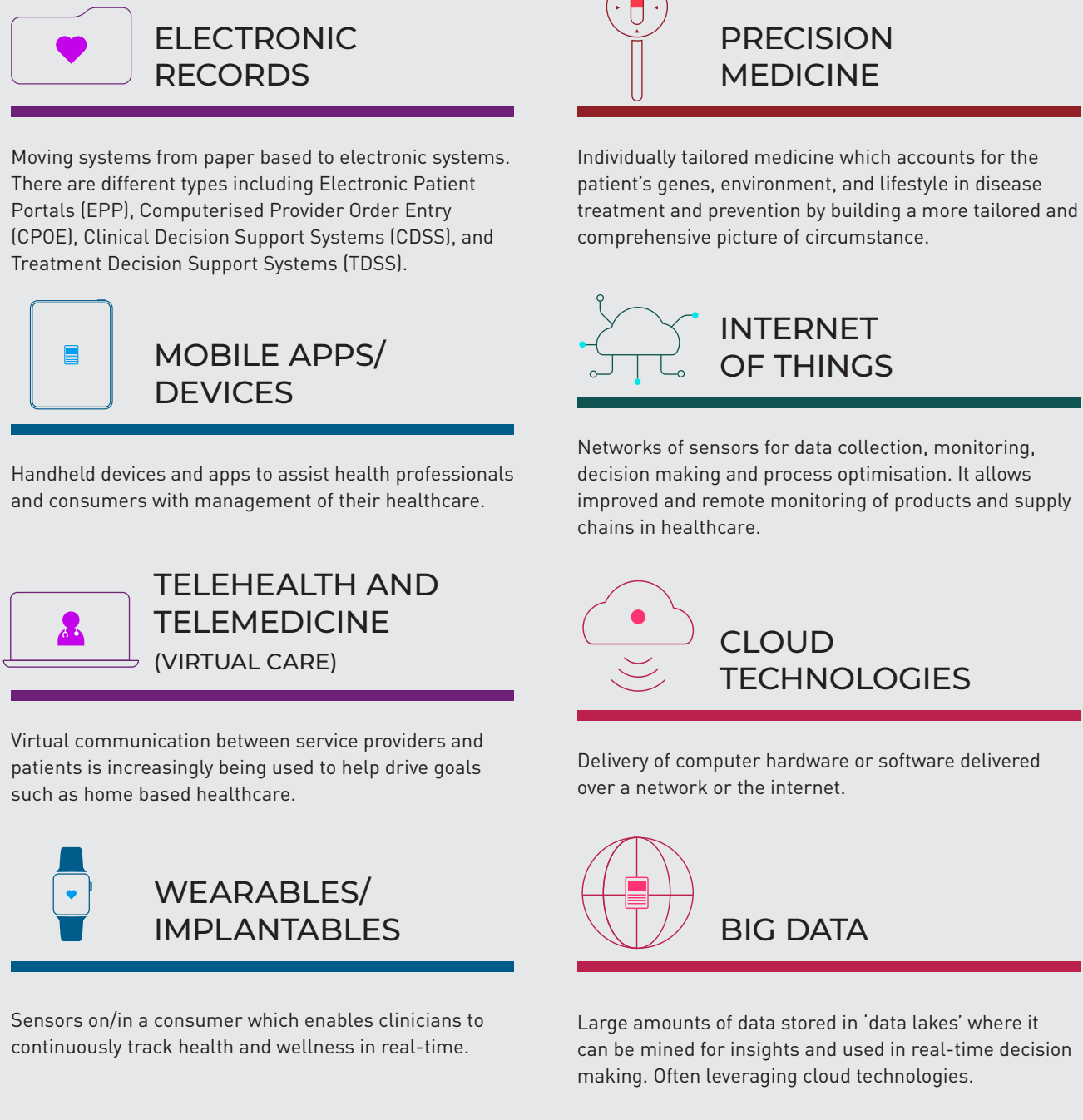
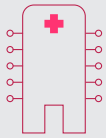
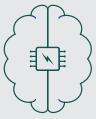


Figure 1 continued: Technologies impacting healthcare



DIGITAL HOSPITALS

The convergence of digital technologies designed to create an entirely paperless and integrated system that links consumers, clinicians, assets and information systems used throughout the hospital.

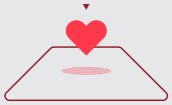


ARTIFICIAL INTELLIGENCE

Intelligent behaviour by machines for a specific purpose or "narrow AI". Machine learning is included in this as a type of AI that enables software applications to become more accurate in forecasting (without being programmed to do so).

ADVANCED ROBOTICS

Robots with enhanced senses, dexterity and intelligence used to automate tasks or processes.



AUGMENTED REALITY

Enables supplementing of usual senses with computer generated graphics, video, sounds or geo-location information.

3D PRINTING

This refers to where material is joined under computer control. In the health context, it is being used in a variety of ways including personalised prosthetics, bioprinting and skin for burn victims.

GENOMICS

Fast and low cost gene sequencing and synthetic biology.

SECURE MESSAGING

Reliable, secure provider-to-provider communication. Secure messaging is a core foundational capability required to enable interoperability and safe, seamless secure and confidential information sharing across all healthcare providers and consumers.

Source: KPMG modified based on Institute, 2013[21].

2 About the roadmap

2.1 What is the National Digital Health Workforce and Education Roadmap?

The *National Digital Health Workforce and Education Roadmap* (the roadmap) identifies the impacts of digital health adoption on the health workforce and the enabling education programs required to build digital health capability across Australia. As a key part of this, the roadmap considers the contexts and settings within which the health workforce operates, and the different digital roles that are required now and into the future. The roadmap also starts the process of developing a clear workforce and education development pathway to help deliver the changes required.

> *"Technology on its own … no matter how effective the platform, will not bring about changes in the behaviours of clinicians. An implementation strategy which addresses the barriers to effective adoption of these technologies will be critical to their success"*
>
> *Australian Digital Health Agency, 2018*[22]

Key health, education and accreditation partners will play substantive roles in the development of the resources and curriculum required to support the workforce capability development. There are pockets of innovation where this is already occurring. The roadmap is the strategic document providing a context for health sector leaders to agree and prioritise activities in order to achieve workforce and education changes.

The roadmap as such is a strategy. It does not contemplate in detail the roles and responsibilities, timeframes and targets, which will be subject to the development of a Capability Action Plan (CAP). This will be developed in close concert with all partners, including government, universities and education providers, accreditors, and clinical and consumer peaks. This process will ensure the CAP appropriately represents sector priorities, can harmonise the work already occurring both nationally and within jurisdictions, and has funding sources identified. It will also ensure that roles and responsibilities are clear, and organisations are supportive of the approach. This is planned to occur following finalisation of the roadmap and is a critical next step to ensure implementation of the roadmap and realisation of the benefits that will flow to Australia's health workforce.

2.2 A holistic view of the health workforce

The term 'health workforce' has been defined in different ways. In many instances, definitions focus on clinical roles and activities.

Definition of the health workforce

For the purpose of this roadmap, the term 'health workforce' is defined to encompass 'all individuals who deliver or assist in the delivery of health services or support the operation of health care facilities'. This definition includes health care professionals, such as nurses, midwives, doctors, aboriginal health workers, allied health professionals, and all other workers in the health system such as administrative assistants, health technology professionals and wardspersons. It encompasses the 'workforce in health', and from herein will be referred as the 'health workforce'.

The education requirements of consumers, their carers, and volunteers are also considered within this roadmap.

The potential benefits of digital technologies in the health sector extend beyond those roles directly concerned with the provision of healthcare. The roadmap applies to all of the workforce employed in health, from those providing linen and food services, to those involved directly in the provision of healthcare, and to managers, administrators and executive.

In addition to the paid health workforce, a range of other stakeholders are important in the development and adoption of digital health innovations. Consumers must be central to the design of new digital health systems and services and have an important role to play in the adoption of tools and in the maintenance of health data[23]. There is also a range of important volunteer roles including carers and peer workers who can be instrumental in facilitating the beneficial adoption of digital health.

The digital health workforce includes the wide spectrum of actors across the sector (clinical and non-clinical, paid and unpaid) who support the achievement of health outcomes.

2.3 The digital capability of the health workforce

Ultimately, the National Digital Health Strategy's vision cannot be achieved without improving the digital capability of the health workforce. Digital health is inevitably changing clinical roles and functions, and how individual professionals and teams work. Effective integration of digital technologies in mission critical environments like healthcare demands new capabilities, new roles and new models of care.

> *"There is little point investing in the latest technology if there is not a workforce with the right roles and skills to make use of its full potential to benefit patients."*
>
> *NHS, 2019*[24]

Education and training are essential to enabling the capability uplift that is required. The impacts of digital health are pervasive and are already influencing the education and training needs for a significant component of the more than one million people who comprise the health workforce[25]. It is essential to recognise the differing levels of maturity of the current health workforce across settings, professional groups, employers and jurisdictions, and the challenges some jurisdictions will face in addressing these needs[26].

A multi-pronged approach that takes into account different needs across the health workforce, traditional and emerging methods of education and training delivery, and different learning styles is needed. The approach also needs to consider barriers to accessing education and training providers and identify suitable education and training partners with expertise in digital health.

2.4 Transforming the workforce

As with any transformational change in a complex system, there is, and will be, pockets of innovation, enthusiasm and drive alongside areas of resistance, scepticism and ambivalence[27]. To be successful, the work that follows the roadmap must address the human barriers to success and leverage active support.

Having an effective approach to delivering the roadmap requires:

- Understanding of the complex operating landscape in health, and the importance of its linkage to other broader health workforce initiatives and strategies at a federal, state, local and health organisational level.
- Establishing a single national view that reflects the diverse range of health workforce stakeholders and considers different levels of maturity. This includes meeting the needs of the Australian health jurisdictions and the different health professions[28]. It also considers the different healthcare settings, degree of digital inclusion and the different contexts across the healthcare sector (including aged care, primary care, specialist care and home and community care, delivered in remote, rural, regional and metropolitan contexts, and emergency, acute and rehabilitative care delivered in hospitals).
- Ensuring that the roadmap draws on the range of existing initiatives and progress that has already been made in digital health workforce capability in Australia. This includes an approach that provides capability growth in a targeted and structured way, noting that different segments of the workforce will need different levels of capability.
- Acknowledging the need for a greater emphasis on privacy, security, and ethical considerations in regard to workforce education to ensure potential risks to community acceptance can be mitigated.
- Noting the lessons learned to date across many environments, both locally and internationally. For example, the large-scale and relatively swift adoption of EMRs within the United States following the introduction of the HITECH (Health Information Technology for Economic and Clinical Health) Act 2009 saw increasing regulatory and administrative burden placed on clinicians, leading to the introduction of a strategy on 'Reducing Regulatory and Administrative Burden Relating to the Use of Health IT and EHRs'[29] by the Office of the National Coordinator for Health Information Technology (ONCHIT) (the final report of which was released in March 2020).
- Acknowledging the need for alternate approaches to technology and telehealth adoption in remote Aboriginal communities.
- Ensuring alignment with the work that has already been undertaken at a Commonwealth, and state and territory level, including coordination with a range of other workforce planning and capability frameworks under development. This includes ensuring digital health capabilities and competencies underpin accreditation standards and programs.
- Achieving buy-in from key stakeholders in order to improve capabilities and address change resistance and change fatigue around the adoption of new digital technologies.
- Addressing changing consumer expectations. This is particularly relevant in meeting the needs of vulnerable population groups, including those who face health access challenges. This includes people in remote, rural and regional areas who rely on technologies (such as telehealth[30]) to meet their healthcare needs.
- Support for staff working in the community setting to have greater access to mobile technologies and services to assist them in performing their role.
- The roadmap and CAP to effectively respond to a dynamic and changing environment and to continue to be relevant. The need for flexibility must be balanced against the need for accountability, specific targets, and measures against which progress can be tracked.
- Prioritising capability development in the context of a fiscally constrained health system, where there is pressure to meet the growth in demand for health services. Capability development in digital health therefore needs to free capacity so that healthcare providers can work more efficiently and effectively and improve patient care, and reward workforce investment in ongoing learning and development.

2.5 Capability for digital health: development principles

The following principles have been used in the development of the roadmap. These reflect feedback from key health, education and consumer stakeholders. These principles should inform the further work and action planning that is required to deliver workforce and education capability uplift.

Table 2: Roadmap development principles

National alignment, collaboration and accountability	The roadmap provides a context for health sector leaders to agree and prioritise activities to develop resources, curricula, clinical resources and networks that are required to achieve workforce and education changes. This enables enhanced collaboration across Australia (including across health professions, jurisdictions and education and training providers), consistency and reduced duplication of effort. This also includes alignment and integration with emerging health workforce strategies, such as those being developed by the Commonwealth, and within state and territory jurisdictions.
Flexibility to respond to diverse digital technologies and operational environments	The roadmap promotes flexibility and adaptability in order to respond to future changes. It is digital platform agnostic (not constrained to a specific digital system, tool or technology) so that it remains contemporary, recognising that open standards also have their place. It also reflects the differences that may occur across a range of contexts (rural and remote, regional, and metropolitan) and settings (primary care, acute care, aged care[31]).
Leveraging partnerships to drive innovation	The roadmap encourages national support for digital health innovation, improvement and research-related activities. Facilitation of these activities should be through partnerships between key health and education stakeholders. The roadmap also recognises career development pathways and the central notion of lifelong learning.
Delivery of equity of access to healthcare for all Australians, acknowledging the requirement for digital inclusion	The roadmap considers the different consumer needs across the health system, noting that there are a number of stakeholder groups who, for various reasons, may not readily adopt digital solutions. Digital health should increase equity of access to healthcare and wherever possible technologies should provide greater access to quality healthcare. Investments in digital health should focus on the areas of greatest benefit.

Table 2 continued: Roadmap development principles

Ethical use of data and information	The roadmap identifies the key benefits expected through achieving the vision for digital health, and acknowledges the implications digital health may have for data privacy and security.
Responds to government and community priorities	The implementation of the roadmap will need to be responsive to emergent government and community priorities. For example, the current focus on aged care may result in a need to implement digital health workforce capability with a greater sense of urgency and efficiency. This includes consideration of changes that have occurred in response to the COVID-19 pandemic, and how these changes may be sustained in the medium to longer term.

2.6 Out of scope

The roadmap is intended to provide a common foundation for the work that will be performed by a broad range of health system participants to address the challenges and opportunities presented by digital health. It is not intended to catalogue all initiatives that will be required to support the transformation of the health workforce. While it anticipates the changes that are likely to reshape healthcare delivery, it is not intended to plan for their implementation. Some consideration has been given to participants' roles in enhancing workforce digital capabilities. However, further consultation will be required to develop a cohesive CAP with specific actions, targets and measures of success. This consultation will be undertaken in close collaboration with all Australian jurisdictions, university and education providers, clinical and consumer peaks and accreditation authorities, and will commence as a critical next step.

Setting the scene

3 Setting the scene

Understanding the current state of digital health adoption in Australia and globally provides an important context in which to consider the shifts required to realise the potential of digital technologies in healthcare. The following section of the roadmap is informed by a global literature scan (Appendix A) and consultation with stakeholders (Appendix B)

3.1 The global picture of digital health workforce initiatives

Digital literacy in healthcare is currently determined largely by the way each country defines digital health and the types of services that fall into this definition. Electronic medical records (EMRs) and their implementation remain the primary focus for many health systems globally and are often the principle input to assess digital health maturity. The interoperability of the information contained in these EMRs is recognised as an emerging and critical priority.

A common theme across the literature points to a fragmented approach to health workforce education. The changing healthcare needs of our population (driven largely by ageing and the increased prevalence of chronic disease), changing consumer expectations, and rapid technological advancements, have resulted in complex health systems with multiple actors. This creates challenges in the delivery of a consistent approach to health workforce education and training within a constrained funding environment.

In recent times, there has been significant interest in emerging literature that examines the future of work and the impact digital technologies will have on the health workforce, or indeed are having. However, there has not been as much focus on the planning, programs and strategies required to improve the digital health literacy of the health workforce. Likewise, there has been limited consideration of the differences across health professional roles, settings and contexts, and is further challenged in settings where digital inclusion is lowest.

The desktop review (Appendix A) focused on the UK, Scotland, Canada, Israel and Europe due to the emergence of digital health workforce and education initiatives. Each of these geographies has focused significant government investment in digital health. This has resulted in health technologies advancing at a faster pace than the integration of digital health learning into workforce education.

Leading policy organisations such as the World Economic Forum (WEF), International Labour Organization (ILO) and the Organisation for Economic Co-operation and Development (OECD) have drawn attention to the need to plan for the transition of capability across health sectors globally.

The WEF emphasised this for the health workforce noting that 'few industries have the potential to be changed so profoundly by digital technology as healthcare'[32]. However, this is yet to translate into workforce competency frameworks or deep analysis regarding the implications of the 'digital revolution' on the health workforce. Part of the challenge may be in defining what is meant by 'digital health', and the reliance on employer-provided training in new systems as they are implemented. Initiatives aimed at developing baseline digital literacy across both the current and future health workforce are largely absent.

Further, key findings from the *State of Digital Health* 2019 report (The Global Digital Health Index) reveal that "...there is still a significant amount of work to be done to improve the digital health ecosystem, with the two weakest areas in standards and interoperability and digital health workforce development[33]".

Three core themes emerged from the desktop review:

- The lack of an overall digital health competency framework;
- The variation in digital maturity across health specialities; and
- The need for a partnership approach to advance the progress of digital health capability globally.

There is no single agreed global framework or commonly accepted scale for defining digital health skills or capabilities[34,35]. The UK developed its framework to categorise and define digital health skills, with six key domains of digital capabilities and a diagnostic tool to assess the current levels of digital literacy. Though the UK has led the way in publishing a digital health capability framework, the lack of a single agreed framework presents a challenge to measuring digital capability levels across the health workforce as well as for recruiting to emergent roles.

Different levels of digital health adoption and maturity are emerging across the health professions and settings. Primary care has led the way in the adoption of new technologies, whereas specialist areas of care are slower to adopt with more health professionals continuing to rely on paper-based records. This variation in digital maturity has been partially attributed to the different technologies that are emerging across various specialities

> *"The adoption of digital technologies and the associated occupational changes are neither experienced at the same pace in all industries, nor influencing all occupations to the same degree"*
>
> *RMIT University, 2019[36]*

The ecosystem supporting the digital health education of the health workforce is diverse and home to many players. There are limited formal education pathways, including those provided via universities and a range of other education providers. Employers provide education and training to staff, although these initiatives may focus narrowly on specific systems or single technological implementations. There is an argument in Australia to establish a minimum standard of digital health-based education and training that would deliver a nationally accredited set of skills that is transferrable between states and territories.

Further detail on the five geographies profiled through the literature scan is provided in Appendix A: Global Insights.

Further investment is required to realise the digital health potential

Differing technologies are expected to be adopted and influence care provision across the sector at varying times and to varying degrees. It is difficult to assess the extent to which subsectors and specialisations of the health industry will be impacted. However, it is clear that technologies can be divided into those that will augment existing care and those that have the potential to transform care[37]. For example, AI has the potential to impact multiple sectors and transform care; however, users need to trust the AI applications developed by business, governments and academia.

The degree to which areas and roles will be affected by digital health will be influenced by the nature of the tasks performed by workers in the area, and the path of technological evolution. For example, the role of 'care coordinator' is an emerging professional role that is becoming increasingly important as many consumers now present with complex chronic conditions, requiring care from a number of healthcare providers. This role will become increasingly focused on leveraging data to drive more effective and connected treatment and care[38].

The contemporary literature recognises that there is great potential for disruption in healthcare from digital technologies such as AI, natural language processing and genomics[39,40,41]. It is broadly agreed that healthcare is taking a similar transformation trajectory to other industries that are being disrupted and then transformed by digital technology. It is projected that as in other industries, innovations in healthcare are on course for exponential growth over the next decade[42]. Yet the rate of technological uptake and disruption is particularly challenging to predict for the health workforce in light of the unique barriers to adoption faced by the healthcare industry, including cultural, regulatory and systemic barriers. This disruption can also be a distraction and deterrent for better health outcomes.

Despite the increasing capture of data, there have been challenges to standardising and promoting interoperability across the health sector. There are also barriers to accessing and sharing data due to privacy regulations and data sensitivity. Without investment and regulatory change, these challenges are expected to continue to hinder the progress of digital health-related transformation across the sector. Traditional workplace mindsets and attitudes that date back through the history of some health professions may also serve as barriers to innovation and digital adoption, particularly when it comes to technologies that may augment the delivery of care. There are a number of factors that influence the adoption and impact of emerging technologies such as:

- **Variance in application:** Technologies have the potential to impact a wide range of specialities in different ways, such as predictive analytics using AI to enable health professionals to monitor and predict health trends[43].
- **Time to adoption:** The rate of adoption will vary significantly between technologies. For example, predictive analytics using AI is expected to affect 20 per cent of the workforce by 2025, while reaching 80 per cent by 2040[44].
- **Applicability to specialisation:** The application of technologies will be specific to certain specialities. For example, the use of robotics will continue to develop in surgery, automated image interpretation using AI will be important to radiologists, while precision medicine will be of greater use to general practice[45]. Humanoid robotics can perform concierge, translation and navigation functions so may have applicability greeting patients and visitors coming into a hospital[46].
- **Maturity of technology:** Maturity will play a role in technology adoption, such as genome editing. This technology will need to have safety and predictability satisfied prior to widespread use, accessibility and broad adoption.
- **Legal and ethical frameworks:** The legal and ethical implications of some technologies will be complex. For example, the ethical implications of applying AI in healthcare are still being considered.
- **Consumer demand:** The adoption of technologies will always be influenced by consumer demand. For example, an increase in the prevalence of skin cancer is likely to drive the need for technologies that improve efficiency in diagnosis, such as AI and teledermatology services[47].
- **Cost and value for money proposition:** The upfront costs for investment in digital technologies can be prohibitive, as can the ongoing costs. The value for money proposition can be difficult to justify in the face of other priorities, particularly where the evidence base or impact on health outcomes is at times predictive and still emerging.
- **Digital inclusion:** With a growing range of education, information, government, and community services moving online, internet access is increasingly regarded as an essential service. The benefits of the digital economy cannot be shared when some members of the community are still facing real barriers to online participation. Emphasis should be placed on the alignment of each jurisdiction to a minimum baseline of digital maturity.

These challenges, as well as ingrained consumer and clinical behaviours, entrenched stakeholder interests and other factors present in the healthcare sector are likely to affect the rate of adoption of new technologies, and the scale of change in the sector[49].The WEF has sighted underinvestment in healthcare technology (3 to 4 per cent of revenues) as a barrier[50]. Over the next five to seven years, there will be a need for a 'sustained uplift in investment to unlock the potential of these [technologies]'[51].

On a broader scale, the digital revolution is expected to break down silos across traditional industries such as health, telecommunications and retail. These are expected to become increasingly interconnected and interdependent, providing greater accessibility to health services for people in remote and regional areas. Therefore, in order to understand and plan for the changes in their industries, leaders will increasingly need to have a holistic understanding of technological advancements – both within and outside of health[52].

The COVID-19 pandemic has seen a significant uplift in technology adoption – specifically telehealth, as new temporary MBS telehealth services[53] have been created in response to the pandemic[54]. In the face of the surge in coronavirus disease, clinicians and health systems worldwide have been "racing to adopt virtualised treatment approaches that obviate the need for physical meetings between patients and health providers[55]". There will be important lessons learnt around this uptake that can and will influence technology adoption going forward and the associated impact on the health workforce.

Key initiatives and progress globally

A global scan identified workforce and education initiatives in many geographies including Canada, Europe, Israel and the United Kingdom (Appendix A). The United Kingdom is investing in work to identify how the health workforce can be best supported in their understanding, adoption and effective utilisation of digital technologies. However, it is important to note that while the UK has released a number of national strategies and programs to support digital literacy, research suggests that many of the 239 NHS Trusts do not have high levels of digital maturity[56].

In February 2019 the *Topol Review* was released. It examined how new technologies are expected to change the roles and functions of clinical staff, implications for the skills required into the future, and the associated consequences for areas such as recruitment, education, training and lifelong learning[57]. The *Topol Review* also looked at how the health system will need to change in terms of healthcare economics, organisational development and providing a learning environment that supports digital literacy in the context of continual change.

In addition, the NHS has delivered a number of initiatives that seek to build digital capability. These include:

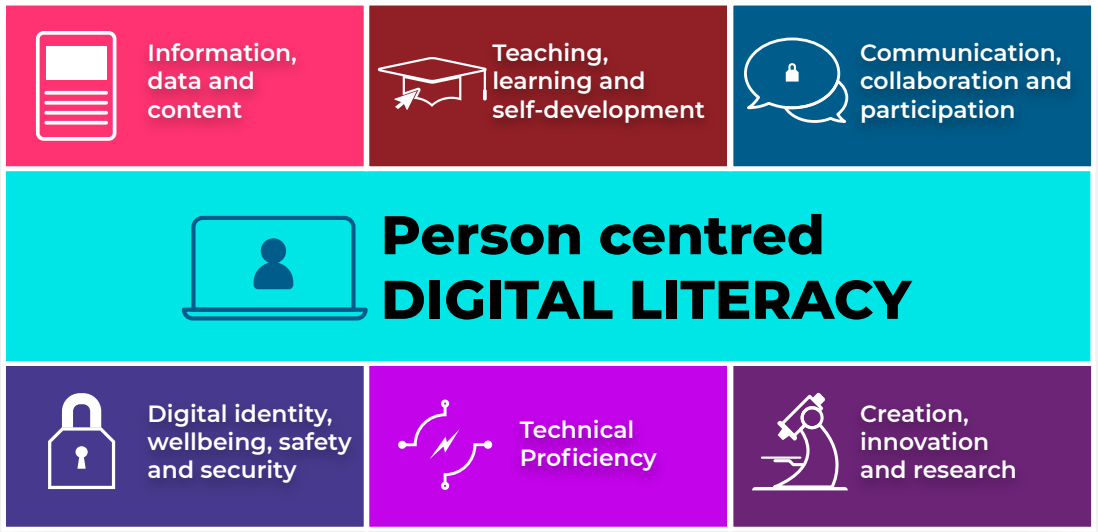
- **The Health and Care Digital Capabilities Framework** defines the digital capabilities expected of the health workforce[58].
- **The Widening Digital Participation programme** aims to improve the digital literacy of targeted disadvantaged consumers. This initial program ran for three years – between 2013 and 2016 – and delivered training to more than 200,000 people. Based on the success of Phase 1, Phase 2 is being delivered between 2017 and 2020. It is piloting 20 different ways to embed digital inclusion into healthcare.
- **Health Education England's (HEE) Technology Enhanced Learning programme** is a digital literacy learning program developed to support the clinical health workforce.
- **Building a Digital Ready Workforce** is a program that seeks to drive a culture of digital innovation. This includes four key work streams focused on leadership and culture, professionalism, digital academy and digital literacy.

There is no single agreed global framework or commonly accepted scale for defining digital health skills or capabilities[59,60]. This presents a challenge to measuring digital capability levels across the workforce as well as for recruiting to emergent roles. The WEF, ILO and OECD recognise the need to plan for the transition of capability across health sectors globally. This is particularly critical for the health workforce.

Capability frameworks as a foundation for digital education and development

The United Kingdom is arguably the most advanced in frameworks used to categorise and define digital health skills. HEE has developed 'A Health and Care Digital Capabilities Framework' that identifies six key domains describing distinct digital capabilities for the overall digital literacy of the health and social care workforce[61].

Figure 2: 'A Health and Care Digital Capabilities Framework' domains



Beneath these broad categories sits a Digital Capability Framework. This includes a diagnostic tool to identify current levels of digital literacy and development areas to assist those who work and train in the NHS and social care.

Other organisations have developed similar frameworks for digital skills in the broader economy. For example, the WEF has developed a framework to facilitate the development of a workforce in which most people are competent, comfortable, confident and safe in their daily navigation of a digitalised work and life environment. The framework identifies eight different digital skills domains[62]:

- Digital identity (digital citizen, digital co-creator, digital entrepreneur);
- Digital rights (freedom of speech, intellectual property rights, privacy);
- Digital literacy (computational thinking, content creation, critical thinking);
- Digital competencies (online collaboration, online communication, digital footprints);
- Digital emotional intelligence (social and emotional awareness, emotional regulation, empathy);
- Digital security (password protection, internet security, mobile security);
- Digital safety (behavioural risks, content risks, contact risks); and
- Digital use (screen time, digital health, community participation).

These initiatives and others are described in greater detail in Appendix A. While these examples are important reference points, there remains significant work to be done to establish a comprehensive view of the workforce and education priorities in the Australian context.

Partnership approach to driving digital education and development

The Israel Innovation Authority, via the Israel-Europe Research and Innovation Directorate (ISERD), announced a partnership between Israel and Finland in the field of digital health. This project aims to provide funding and match services for Greater Helsinki-based and Israeli companies seeking to partner in order to co-develop, test, improve, or pilot impactful technologies, products, services and/or devices. Such products have a strong market potential in the fields of digital health, smart mobility, and information and communication technologies (ICT)[63].

> *"Collaboration with Israeli companies will help Finnish start-ups … protect Finnish citizens' well-being and maintain Finland's status as a global leader in healthcare technology. This is also an extraordinary opportunity for Israeli companies to connect with Finnish leaders in the digital health ecosystem, gain exposure to new cutting-edge technologies, receive support for meaningful innovations, and tap into the Finnish market."*
>
> *Aharon Aharon, CEO Israel Innovation Authority, 2019*[64]

3.2 The current state of Australian digital health

The digital capability of the health workforce and education is an emerging area

There is an increasing volume of resources published and an increasing number of conferences on digital health and related topics. This suggests that digital health is increasingly recognised as an area for research, capability development and investment[65]. Specialised areas of digital transformation are explored in the literature as are government strategies, such as those that focus on the impact of genomics and artificial intelligence[66]. The scale of this analysis is not commensurate with the scale of impact that the digital technologies are projected to have across the health workforce over the short to medium term, and the longer-term potential of technologies such as quantum computing that are currently in research laboratories.

There is no single agreed definition of digital health or digital health capabilities

Due to the increasing rate of change of new technologies, the term digital health is broad, and its definition will continue to change as new health technologies emerge. This creates a challenge in creating a clear and consistent understanding of digital health.

However, industry leaders across Australia agree that the definition of digital health has evolved, moving from a focus on eHealth to a wider view that encapsulates mobile health and wearable devices, personalised medicine, telehealth and telemedicine, and all innovative evidence-based products and services that change clinical outcomes for consumers[67]. Increasingly, digital health is looking beyond electronic storage of data towards the use of the data to drive insights and improve service delivery.

There is presently no single national capability framework that provides the language to define digital capability. There are, however, initiatives that address these digital skillsets in the broader economy[68], such as those developed by the National Centre for Vocational Research (NCVER). Despite this, RMIT research recently concluded that more work on digital capabilities is required.

> *"A broader appreciation of the digital environment is absent. This is a significant shortcoming in an emerging digital economy, where the future of work is likely to be dominated by digital technology and workers will be required to master not only specific tools in specific contexts but also a higher level of overall digital competency."*
>
> *RMIT University, 2019[69]*

At present, the most recognised credential in the area of digital health is the CHIA (Certified Health Informatician Australasia) certification program. The program *'has been designed to address the lack of formal recognition for health workforce informatics skills in the Australian health workforce'*, and to provide independent validation of digital health skills. It has been developed in partnership by the AIDH and the Health Information Management Association of Australia Limited (HIMAA). It includes an online exam that participants are required to pass to gain this certification.

As a prerequisite, participants must have a degree and three years of 'associated experience', or five years of 'associated experience' with no degree. By virtue of the experience requirement, the course attracts those working in the field of health informatics, health administration/management, clinical information systems, eHealth, health information systems, and health information management[70].

While widely recognised, this certification has not been broadly adopted or embedded within the health workforce[71]. An increasing number of clinicians are undertaking the CHIA program. This may be undertaken in their own time, and it requires a significant amount of study to complete the course[72]. For some, this means that they are unable to undertake the exam within the required timeframe or fail the examination.

The CHIA program is a significant step in recognising the professionalism of the health informatics workforce. Many stakeholders noted that there is still a need for a program that supports general digital health literacy (with wider application than the current intended audience of CHIA). The need for this program – and others, given the complex nature of digital literacy – to include the emerging digital technologies beyond eHealth and electronic medical records was also noted.

There are pockets of innovation across Australia focusing on improving digital health capability

There are a number of initiatives seeking to build digital health capability for segments of the health workforce. The AIDH[73] and others[74] have developed useful inventories of existing digital health education resources. Numerous examples were also cited in consultations supporting the development of the roadmap (Appendix C). Examples include the Australian Digital Health Agency and AIDH co-production on the development of digital capabilities required for the nursing and midwifery workforce in partnership with key nursing and midwifery peak bodies, and the green paper on digital health developed by the Royal Australian College of Medical Administrators (RACMA). There are also pockets of innovation happening within specific universities, and for the public health workforce in some jurisdictions.

A stakeholder consulted in the development of the roadmap reflected *'we need to be aware of the thousand flowers blooming'*. There is broad support to develop a national strategic framework that helps to align these pockets of activity.

Levels of digital maturity and investment capacity vary considerably

Different levels of digital health adoption and maturity are emerging across the health professions and settings. The general level of maturity and investment in digital technologies in rural and remote communities is lower than elsewhere. In some areas, there is limited access to information technology infrastructure – especially in areas with limited or no internet access – which may cause delays in the ability to record information and require the need for paper systems as a backup. The impact of connectivity issues can lead to a very poor consumer and patient experience, with potential data and safety ramifications. The lack of information sharing is a pain point and frustration for many Aboriginal and Torres Strait Islander health workers who work in rural and remote communities.

Primary healthcare has seen strong adoption of electronic records and systems, as well as telehealth – which has seen unprecedented growth during the time of COVID-19, but there have not been significant advancements in the adoption of emerging technologies in the last few years. This could be due to technology adoption barriers, including access to funding, investment risk, and access to expertise in the adoption of technologies.

In Australian hospitals, there has been significant growth in the use of integrated electronic medical record systems, led by significant rollouts in New South Wales and Queensland, and further expansion in Victoria. Further work is underway in South Australia with the transition from the Enterprise Patient Administration System (EPAS) project to a new EMR project, and in Western Australia, Tasmania and the Australian Capital Territory with digitised medical records. The Northern Territory is undergoing the replacement of bespoke systems under the Core Clinical Systems Renewal Project (CCSRP)[75]. In specialist care (medical specialities) there is still widespread use of paper-based records. However, change is occurring with the emergence of the next generation of medical specialists who expect to use electronic records.

Different health technologies are emerging across various specialities. This comes with the challenge of requiring the different medical colleges to accredit and support the continuing professional development (CPD) linked to changing processes, functions and practice in those specialities. In addition, private practice specialists are usually small to medium enterprises and, as with primary care, this creates barriers to digital adoption.

Stakeholders have consistently recognised pharmacy as leading the adoption of new technologies (including My Health Record) and exploring new ways of working. Pharmacies gain access to information including clinical histories and hospital discharge summaries. This enables them to provide better services to their customers through the use of My Health Record. In this way, digital health adoption may help independent pharmacists who face competition from warehouse models[76].

Strong leadership, along with the development of tools and resources, has supported the uptake of My Health Record. These tools and resources include introductory workshops, webinars and CPD modules such as support resources produced by the Agency[77]. Other health professions require further investment to move to electronic records and to explore opportunities presented by digital health.

There are barriers to digital health innovation and education

Many of the stakeholders consulted in the development of the roadmap are passionate about digital health. However, there have been a number of barriers to digital health innovation and the development of digital health education:

- Some concern from universities, colleges and accreditation providers about the addition of digital health content in curricula due to 'curriculum crowding';
- Difficulty accessing training sandpit versions of digital health used in state and territory health systems to provide students with 'hands-on' experience;
- Limited demand for digital health-focused subjects in universities, possibly due to a perception that these are only applicable to health informaticians;
- The lead time to develop curricula (especially in vocational education) is too long to meet employers' needs. This results in employers pursuing micro-training and just-in-time training for employees, which tends to focus more narrowly on the specific digital health being implemented;
- Resistance to innovations that blur existing scope of practice boundaries or which do not align with funding models tied to 'atomised' tasks; and
- Thin margins and, in many areas of the health sector, relatively small business scale (such as small general practices) that impose limitations on investment capacity.

Patients and consumers expect digital health to improve their healthcare experience

A relatively small set of in-depth consumer and patient interviews were conducted as part of the development of the roadmap[i]. While the sample was small, the perspectives drawn from these interviews align with broader consultation exercises undertake by the Agency during the development of the National Digital Health Strategy (NDHS), in addition to exercises undertaken during the My Health Record Expansion Program. These provided a sharper lens on consumer and patient digital health experiences and perceptions.

Patients and consumers identified digital health with My Health Record. Only a minority of patients and consumers consulted mentioned other technologies such as pacemakers, heart monitors or hearing aids. After being prompted on the broader range of tools and services that could be included under digital health, the majority of patients were open to the idea of digital health and felt it was the way of the future.

Those interviewed believe that the future role of digital health will not replace face-to-face contact but will complement and support it. Some patients consulted also had an expectation that streamlining services and information sharing would facilitate more meaningful discussions. Patients and consumers perceived greater information sharing and transparency between health professionals and patients (many believed this was already occurring), and patient empowerment with greater access to services as the benefits of digital health services and tools. These views are concordant with the findings to date observed during the development of the NDHS and the My Health Record Expansion Program.

They see opportunities including:

- Scheduling: introducing efficiencies in booking appointments and reducing waiting times (to get an appointment and time spent waiting in clinics or hospitals);
- Monitoring results and conditions: patient data digitally shared with professionals; and
- Accessible information: patients and health professionals both having access to patient condition information (patient checklists, condition information and care/treatment plans).

According to the interview findings, patients and consumers with chronic complex health conditions who visit multiple health professionals are most open to digital health services and tools. They are also more likely to do research online prior to visiting a health professional and are already using a number of digital tools. Those that live in remote or rural areas and/or have confidence regarding online privacy are also likely to be open to digital health. Patients with a close relationship with their GP, fewer medical appointments, and greater concern regarding online privacy are least open to digital health services and tools.

Stakeholders engaged during the roadmap consultation process identified cohorts of consumers with a lower readiness to adopt digital health. This may be due to numerous factors such as comfort with technology, challenges in accessing learning, and physical difficulties using computers and digital devices. Other cohorts identified included those that may be suspicious of digital technologies and how their data may be used. It is possible that the limited sample consulted in the roadmap development did not fully reflect the diversity of views present in the broader population.

i. A total of 15 interviews with patients and consumers were conducted between the 11th and 17th July 2019. The interviews were conducted either face-to-face or over the phone and lasted approximately 45 minutes. Among those interviewed, four identified as Aboriginal and/or Torres Strait Islander, three were from a culturally and linguistically diverse background (CALD) and three were living in a regional or remote location. There was an even split across gender (n=7 males; n=8 females). All patients were aged between 30 and 72 years.

Consumer digital literacy varies and focus on health equality is needed

The *Australian Digital Inclusion Index* in 2019[78] found substantial gaps in digital literacy in Australia. These findings have implications for the way education and training considers the needs of disadvantaged consumers and highlights the need for consumer education and training. In adopting new digital technologies, we need to be cognisant of the consumer digital divide and ensure that digital capability (or the lack thereof) does not create further health inequalities.

> *"...many of the people who could most benefit from digital services are the least likely to be online. One in five people lack basic digital skills and one in eleven people have never been online. These are likely to be older, less educated and in poorer health than the rest of the population."*
>
> *NHS, 2019[79]*

Digital inclusion is lowest for[80]:

- Those who have lower levels of income;
- Older Australians;
- Those with lower levels of educational attainment;
- Those with a disability;
- Those living in remote parts of Australia;
- Persons residing in South Australia and Tasmania; and
- Aboriginal and Torres Strait Islander persons.

However, generalisations should be avoided. There is anecdotal evidence that some disadvantaged groups (such as homeless people) maintain digital connectedness. Further, Aboriginal and Torres Strait Islander people report higher levels of daily usage of social media platforms than other groups[81]. However, more work is required to understand how to leverage this connectedness to drive beneficial health outcomes[82].

> *"We need to be careful that we don't make incorrect assumptions around consumer digital literacy. Even for vulnerable population groups, there may be good take-up of technology"*
>
> *Roadmap Consultation*

The development and adoption of digital health should consider the needs of those without reliable access to internet services including remote and very remote areas[83]. Solutions deployed in these environments must be fit for purpose.

Shared frameworks will help digital health education reach all corners of the health sector

The health and education systems that support the health workforce are complex and involve a number of different stakeholders. Education and training providers across the education system include both accredited and non-accredited courses and programs, programs delivered across the Australian Skills Framework (from levels 1 to 9), university and Vocational Education and Training (VET) providers, accreditation bodies, professional associations that set standards, and national regulatory agencies including the Australian Health Practitioner Regulation Agency[84] (Ahpra), Australian Skills Quality Authority (ASQA), and Tertiary Education Quality and Standards Agency (TEQSA). National boards, specialist medical colleges and professional bodies also influence curriculum design, in some cases directly (e.g. through accreditation processes), and in other cases indirectly (e.g. through the admission criteria). There are also forums such as the Health Professions' Accreditation Collaborative Forum (HPACF) and the Accreditation Liaison Group (ALG) that present opportunities to achieve alignment on issues common to differing professions.

This means that in supporting the Roadmap, there is a need to agree on the respective roles of each of the different stakeholders, establish strong partnerships across the ecosystem, and identify opportunities for collaboration to support greater coherence and unity. Stakeholders have identified shared resources as a way to promote improved coordination and partnership in supporting digital health adoption across the health workforce.

3.3 Selected examples of Australian digital health initiatives

There are a large number of initiatives underway to address digital health and its impacts on the health workforce. A summary of those initiatives identified during roadmap consultation is included in Appendix C. While this does not represent a complete inventory of all work in this area it does provide a useful outline of the breadth of activities taking place. A synopsis of some of these examples is presented below:

Case study: Australasian Institute of Digital Health (AIDH) – Fellowship by Training Program (AIDH FTP)

The Australasian Health Informatics Fellowship Program was established in 2017 as a training pathway to AIDH Fellowship. The program, now known as the AIDH FTP, is designed to prepare individuals for leadership roles in the health informatics workforce and to address the current demands for experienced and qualified specialists from various disciplines[85]. The FTP is four years full-time in duration and includes:

- A health informatics research doctoral program at an Australasian University (typically three years);
- Two paid health informatics 6-month work placements; and
- Supplementary learning.

On completion of the Fellowship Program, candidates will hold a PhD academic qualification, have a portfolio of work and established industry contacts, and will become a Fellow of the Australasian Institute of Digital Health (FAIDH).

As noted by Professor Enrico Coiera, Director of the Centre for Health Informatics, Australian Institute of Health Innovation at Macquarie University, "There is a very real opportunity to create a health informatics training program that will meet the industry demands for highly trained individuals, capable of taking leadership roles in health informatics."[86]

Case study: Digital Health Cooperative Research Centre (Digital Health CRC)

The Digital Health CRC[87] is a $230m seven-year program of work funded by the industry and the federal government to create the digital health future. The program was funded in 2018 and has over 80 partners which include state and federal jurisdictions, primary health networks, private and public services, technology businesses, payers, regulators, peak bodies and 16 universities.

The program is built around four flagships:

- Enabling information and discovery
- Intelligent decision support
- Changing health trajectories
- Transparency of data to optimise clinical practice

Projects address key industry challenges and where possible involve multiple partners across a number of jurisdictions. Over 100 PhDs will be recruited during the program rollout and help form the future digital workforce.

A key deliverable for the program is also in workforce capacity building and this will include the development of education program for PhD students, communities of practice in key areas as well resources to support workforce skills in digital health. The Digital Health CRC is also supporting coordination of education and capacity building in digital health through support for the National Digital Health Workforce and Education Summit.

Case study: eHealth Capability Framework, The University of Sydney and NSW Health

NSW Health and the University of Sydney collaborated to develop the health capability statements to inform and guide consistent high-quality teaching and learning experiences for both workforce health.

The framework has been adopted by NSW Health and outlines foundational levels of knowledge and performance required by all health professionals practicing in digital health care environments. This level directs the expectations of training and entry level of health professionals who provide direct clinical care

The framework includes four domains:

- Digital technologies, systems and policies;
- Integration of digital health into practice;
- Data analysis and knowledge creation; and
- Technology implementation and co design.

Case study: Australian Alliance for Artificial Intelligence in Healthcare

The AI Alliance[88] aims to support and accelerate the adoption of AI-enabled health services in Australia by undertaking essential research, building the national workforce and ensuring AI is safe and ethical.

The alliance brings together more than 50 national and international academics, industry, government departments, peak bodies and consumer groups, with four flagship programs:

- Precision healthcare: researching and translating AI technologies into clinical services so that patients receive the most personalised, safe, effective and timely care possible;
- Consumer health: helping all Australians navigate complex health systems and be active participants in the management of their own care and wellbeing;
- Safety, Quality and Ethics Program: ensuring that those accessing the health system receive safe and ethical care from AI – enabled services; and
- Workforce Program: developing the research, clinical and health service workforce needed to make translational AI programs succeed.

The workforce program brings together professional, educational, industry and academic organisations, with the aim to develop a coordinated approach to the AI workforce, with a focus on three key communities:

- Researchers, who need to understand how to use machine learning while also understanding the risks, biases and challenges in implementation;
- Health service leaders, who need to understand the clinical and organisational risks, as well as benefits of AI, challenges of implementation and impact on clinical workflows; and
- Clinicians, who need to be trained to recognise the strengths and limitations of technology and avoid an overreliance on automation.

Case study: Mapping Health Services Closer to Home, Aboriginal Health Council of Western Australia (AHCWA)

In 2016/17 AHCWA identified that there was a lack of clarity in the community about what health services were available, when they were available and how they could be accessed. The AHCWA, with funding from the WA Department of Health, developed a tool called Mappa to address these challenges.

The Mappa project is developing a free to use online mapping tool that will work to improve access to health services for the community. Mappa features strong aspects of cultural safety and appropriateness through aspects such as cultural notices, lore times, seasons, community access and travel notes, alternate community names, and language.

Case study: Queensland Digital Academy (QDA), Clinical Skills Development Service (CSDS)

In 2019, as part of the Digital Metro North Strategy, the Queensland Digital Academy[89] opened, nested in the Clinical Skills Development Service on the Herston Campus of Metro North Hospital and Health Service.

The aim of the Academy, in collaboration with Clinical Excellence Queensland (CEQ) and eHealth Queensland, is to provide a centrally coordinated hub and spoke approach to train staff in multiple locations across the state. It offers educational opportunities in digital healthcare to develop digital literacy, support digital transformation and build digital leadership capacity and capability across Queensland Health. To effectively harness the value of our digital transformation, Queensland Health's strategic direction for clinical education must be responsive and adjust its curriculum to meet the evolving needs of our interconnected health system[90].

The workforce and education outcomes include:

- Sponsoring staff to grow digital capability through the Certified Health Informaticians of Australasia (CHIA) certification and supporting staff with additional learning support.
- Computer fundamentals – scaffold approach to ensure 'no one is left behind' and that basic computer skills and touch-typing practice is accessible, so staff are more comfortable to work in the digital environment.
- Digital onboarding sessions and EMR introductory sessions to grow the digital knowledge of our key leadership and governance group members.
- University partnerships – designing undergraduate and postgraduate curriculums.
- Monthly digital health grand rounds – sharing insights from academic partners and clinical informaticians working in the digital sphere.
- Leveraging technology to support 'just-in-time' training.

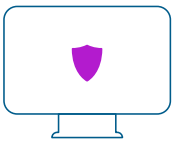
The road ahead

4 The road ahead

Having explored the current context both in Australia and globally and identified salient opportunities and challenges, it is possible to consider the road ahead. The roadmap uses a horizon-based framework to explore the workforce and education changes required to support the beneficial adoption of digital health. Horizons divide the digital health impacts into three broad categories, each with distinct workforce and education implications.

4.1 Strategic horizons shaping digital health, health workforce and education

The horizons outlined in Figure 3 identify the expected impacts of digital health adoption on the health workforce at a strategic level. These impacts are used to provide a view of the education and training that will be needed to support the health workforce. Current levels of digital health adoption vary across the sector. So too will the pace of future digital health adoption. However, there will be common elements on the pathway of adoption as described in the horizons.



Horizon 1: Embedding safe, ethical and effective use of systems of record and consumer data

The vision for this horizon is that healthcare workers and consumers make safe and ethical use of digital health tools and increased access to information, equipping them with greater decision-making power. The key focus from a workforce and education perspective is in improving digital literacy across the health workforce.

Horizon 2: Integrating new technologies and ways of working

The vision for this horizon is that systems and organisations are better connected through interoperability. This will enable them to analyse information, plan, and respond to health demands. Emerging digital technologies will challenge traditional ways of working. The key focus from a workforce and education perspective is on role redesign specific to each profession and specialty area as digital health innovations reshape health functions and roles.

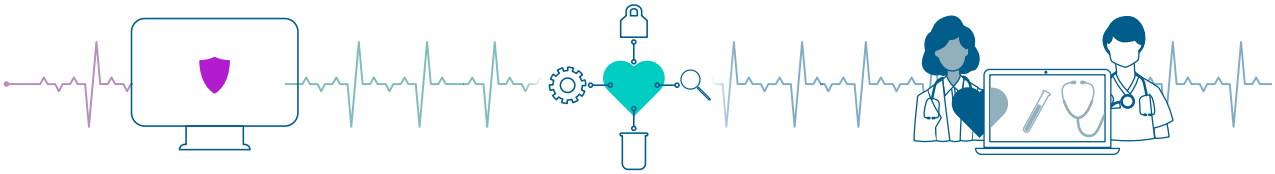
Horizon 3: System transformation enabled by digital health

The vision for this horizon is that healthcare delivery is transformed through value-based healthcare, personalised medicine, empowered consumers, and a shift towards home and community health service delivery and preventative health. The key focus from a workforce and education perspective will be on integrated care and new models of care.

4.2 The horizons have already started – and are overlapping

These three horizons outline the anticipated workforce and education journey for the Australian digital health workforce. However, different parts of the health system and its workforce will progress through the horizons at different rates due to variations in their current state, business readiness for change, and digital health opportunities. There are already pockets of technological innovation driving role redesign and system reforms taking place today in some areas. In other areas of health, the workforce remains reliant on paper-based systems and is slower to adopt digital health. The roadmap deliberately avoids prescribing a fixed end date for the horizons, but it is important to note that, due to the stated variance in uptake, all three horizons are already underway.

Figure 3: Digital Health Workforce and Education Roadmap



	Horizon 1	Horizon 2	Horizon 3
VISION	**Embedding safe ethical and effective use of systems of record** Healthcare workers and consumers have access to digital health tools and increased access to information, equipping them with greater decision making power.	**Integrating new technologies and ways of working** Systems and organisations are better connected, enabling them to analyse information, plan and respond to health demands. Emerging digital technologies will re-shape health functions and new roles will emerge. The focus will be in enterprise transformation.	**Digital health transformation** Healthcare delivery is transformed for example through value based healthcare, personalised medicine, empowered consumers and a shift towards home and community health service delivery and primary and preventative health.
POTENTIAL OUTCOMES & BENEFITS	Efficiency and safety will increase with the introduction of new technologies such as Electronic Medicines Management and My Health Record.	Integrated data sources will be implemented at scale, whilst health technologies will change health jobs (by augmenting or automating tasks) and challenging existing scope of practice.	New models of care will emerge to support the whole of system transformation, such as navigation roles to support consumers.
WORKPLACE CHANGES	Core digital systems will be embedded, consolidating visibility of patient health information and reducing the need for manual data entry.	Enhanced communication through technologies such as eReferrals will increase efficiency, whilst new digital tools will support both patients (i.e. apps for self care) and clinicians (i.e. AI diagnostic tools and genomic pathology).	The use of new technologies will evolve to deliver whole of system improvements through population medicine, precision medicine and predictive analysis.
WORKFORCE AND CAPABILITY REQUIREMENTS	The requirement for change leadership will increase during Horizon 1, with strong delivery of employer provided digital literacy training on the newly implemented EMRs/EHRs.	Nuanced job specific changes will shape capability requirements. Change leadership will focus on Enterprise Transformation, with associated risk and governance frameworks. New technologies will require ethical frameworks and technical capabilities.	Capabilities will reflect new models of care and ways of working including job specific changes (such as health services in the home). Change leadership will focus on System Transformation, with associated risk and governance frameworks.
HEALTH EDUCATION PRIORITIES	Digital Literacy will be the key priority to enable secure and ethical management of individuals' data.	Education pathways that support new and emerging roles in health. Governance, Risk and Ethical training will be the key priority to enable safe and secure ways of working with new technologies.	Governance, Risk and Ethical training will remain important to support new models of care, whilst training on new job requirements will be also needed.
	Now to ~2022	*Now to ~2027*	*Now to beyond 2027*

Horizon 1:
Embedding safe, ethical and effective use of systems of record

4.3 Vision

The focus of the first horizon is on embedding digital health, and extending the safe, ethical and effective use of information systems. In its purest form this is the replacement of paper-based processes with new processes and workflows that integrate electronic systems of record.

Significant progress has been made on existing initiatives across Australia's health system, such as electronic medical records, electronic medication management and telehealth. These electronic systems increase transparency and access to information for patients, empowering patients and consumers.

4.4 Potential benefits and outcomes

Healthcare workers and consumers will have increasing access to digital health tools, creating an opportunity for greater decision-making power. This increased access and uptake of digital technologies brings with it challenges including data quality and accuracy, privacy and consent[91]. In addition, poorly designed or poorly integrated digital health add to workloads rather than freeing of capacity within the health workforce.

Examples of technologies:

- Electronic medical records (EMRs) – EMRs contain information that is created and resides within a single healthcare organisation (such as a clinic, medical centre or hospital).
- Electronic health records (EHRs) – EHRs contain information that can be managed, added to and accessed across multiple healthcare organisations.
- Electronic medication management – electronic medication management systems provide support for doctors, nurses and pharmacists to prescribe, order, check, reconcile, dispense and record the administration of medicines.
- Telehealth – telehealth includes systems that allow patients to connect with healthcare providers in other locations. The three main categories of telehealth technology include remote patient monitoring, store-and-forward, and real-time audio/video encounters.
- Secure messaging – secure clinical communication platforms enable two-way communication between healthcare providers (and in some cases may extend to patients). It provides greater information security and privacy than email and is expected to replace a reliance on facsimile.

The changes to systems, practices and behaviours associated with Horizon 1 are expected to deliver large scale benefits to both patients and the health system:

- Patients have access to digital health tools and increased access to information for greater decision-making power;
- Information is shared appropriately between all relevant health organisations to improve transparency and quality of healthcare;
- Secure messaging and eReferrals enhance clinical workflows and flow of information through the health system;
- Reduced costs through avoidance of duplication of diagnostic scans and pathology tests through the use of EMRs and EHRs; and
- Electronic medications management minimises ADEs.

The benefits of digital health in Horizon 1 are asymmetrically distributed. Patients and consumers benefit from safer care and better information. The health system benefits from cost avoidance and safety. Most of the work required falls to clinicians and other employees within the health system. Poorly designed or integrated digital health may result in additional work for little gain.

4.5 Workplace changes

The further embedding of electronic systems of record is expected to result in a number of changes to workplace practices, including:

- Access to electronic devices and systems for the health workforce in order to record, view, analyse and change health information;
- The redesign of processes and functions integrating clinical information systems. This will result in a transition phase in workplaces as paper-based systems are replaced with electronic systems. Such transition will require planning around the management of, and access to, historical paper-based information. In this transitional phase, there are risks associated with 'hybrid records' where patient details are partially digital and partially paper-based;
- Improved processes and practices that ensure availability, reliability and redundancy of clinical information systems, noting that as the adoption of systems increases, so too does the need to guarantee system resilience;
- More efficient work practices and real-time decision-making driven by improved accessibility to health information and a reduction in manual processing and recordkeeping; and
- Improved processes and practices that ensure health data privacy, patient consent, information security and system access in keeping with both regulatory requirements and public expectations.

4.6 Workforce and capability requirements

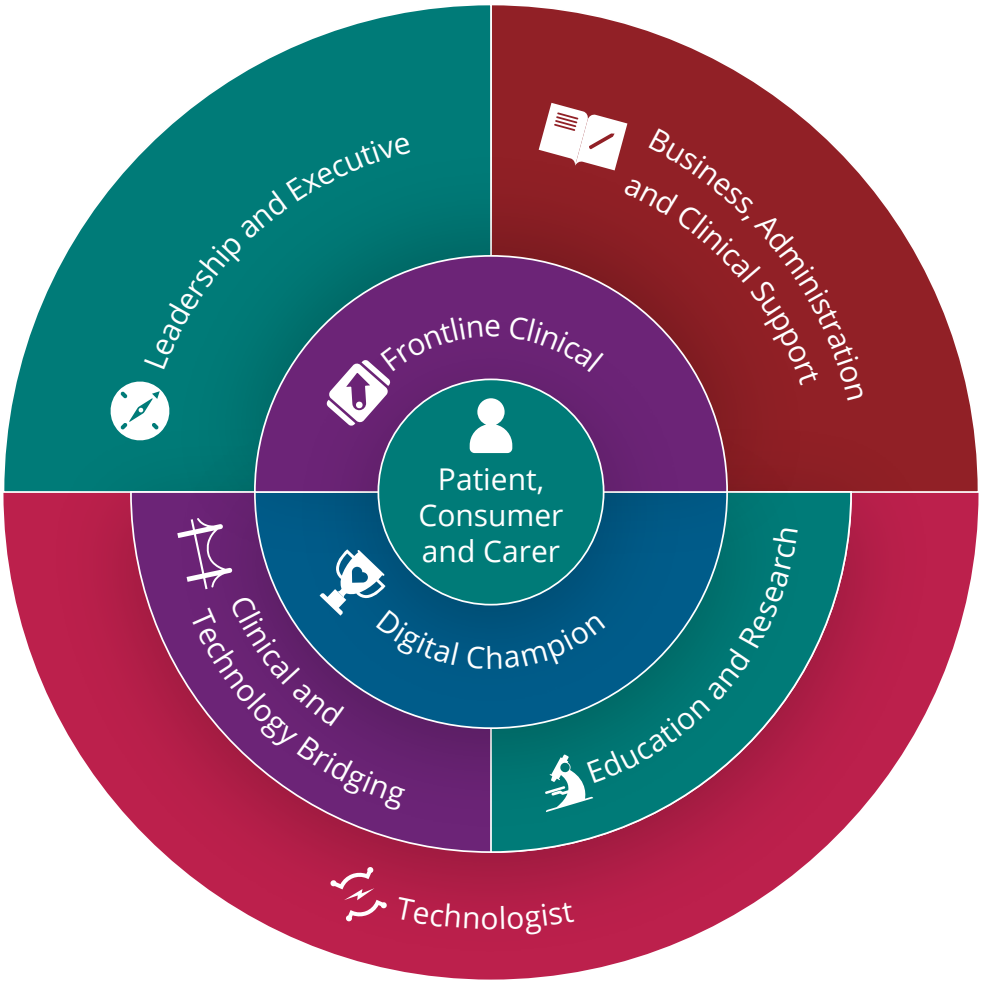
The key focus for the health workforce in Horizon 1 is the development of digital literacy to enable the workforce to understand the challenges presented by digital systems, navigate these systems effectively, and to be supported in the adoption of these technologies so that benefits are realised[92]. As outlined by the *British Journal of Cardiac Nursing*:

> *"It's no longer possible to think about digital literacy as either purely about technical proficiency, or as the preserve of only a few. With regard to health and social care, in particular, the workforce must have sound digital capabilities in order to provide the best care, and to ensure effective personal and professional development."*
>
> *Kennedy and Yaldren, 2017*[93]

While there will be a foundational level of digital literacy required across the health workforce, the depth of essential knowledge will be different based on the various digital health roles and people within the system. Elements of theses digital roles will be consistent across health professions, contexts or settings. Eight digital profiles have been developed to describe the different requirements of the health workforce depending on the role the individual plays in the design, development, implementation and adoption of digital technologies. These are listed below and displayed in Figure 4:

- Patient, Consumer and Carer digital profile;
- Frontline Clinical digital profile;
- Digital Champion digital profile;
- Clinical and Technology Bridging digital profile;
- Education and Research digital profile;
- Technologist digital profile;
- Leadership and Executive digital profile; and
- Business, Administration and Clinical Support digital profile.

Figure 4: Digital profiles



4.7 Purpose of the Digital Profiles Framework

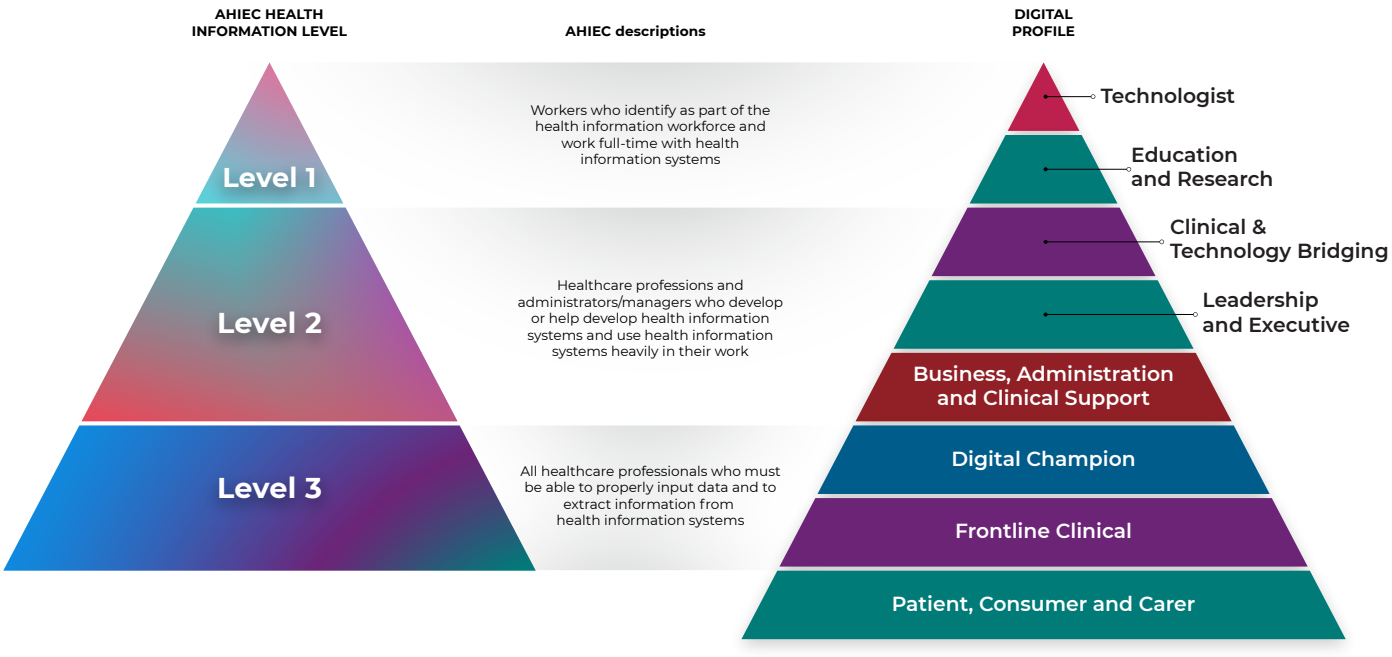
The purpose of the Digital Profiles Framework is to articulate the expectations of the health workforce as a result of the adoption of digital health. It is designed to provide clarity for key education and health partners who will develop curricula, training and resources to assist the workforce, and to empower health workers and consumers to recognise and grow their digital capability.

It is designed to be broad in scope. The digital profiles are applicable in different contexts (including, but not limited to, primary care, aged care, home and community care, and hospitals) and different settings (including metropolitan, regional, rural and remote locations). While they are designed primarily with a health service delivery focus, health policy and planning roles are also included in the Leadership and Executive, and Business, Administration and Support Digital Profiles.

The framework is intended to apply to the health workforce and consumers (including volunteers). Given the variety of occupations and qualifications across the health workforce, this framework is not intended to be specific to individual professions. Instead, it is designed to supplement and support the specific knowledge, skills and capabilities of health professions and specialities.

These eight digital profiles expand on the three-level framework developed in the *Health Workforce Australia* report on the *Health Information Workforce* in 2013 as illustrated in Figure 5. The eight roles adopted address some of the gaps identified by stakeholders with the three-level framework by introducing additional granularity (including the Digital Champion digital profile and Clinical and Technology Bridging digital profile) and incorporating Consumer and Carer and Business, Administration and Other digital profiles. The development of the digital profiles was also influenced by other models including CanMeds[94], Digital Health Canada's Career Matrix and Sydney University NSW Health eHealth Capability Framework.

Figure 5: AHIEC health information levels and digital profiles



Source: Adapted from Health Workforce Australia Health Information Workforce Report[95]

Application of the Digital Profiles Framework

In each profile, the digital health functions and expectations are described in a series of statements. The vision for the future is that individuals will work towards meeting all of the key functions for their identified profile (or profiles). The personas below, in Figure 6 and Figure 7, explain how an individual's role may align to more than one profile due to the ways in which they interact with digital health systems. This is explored in further detail in Figure 8.

Figure 6: Meet Eric – persona demonstrating how profiles apply to individual's roles

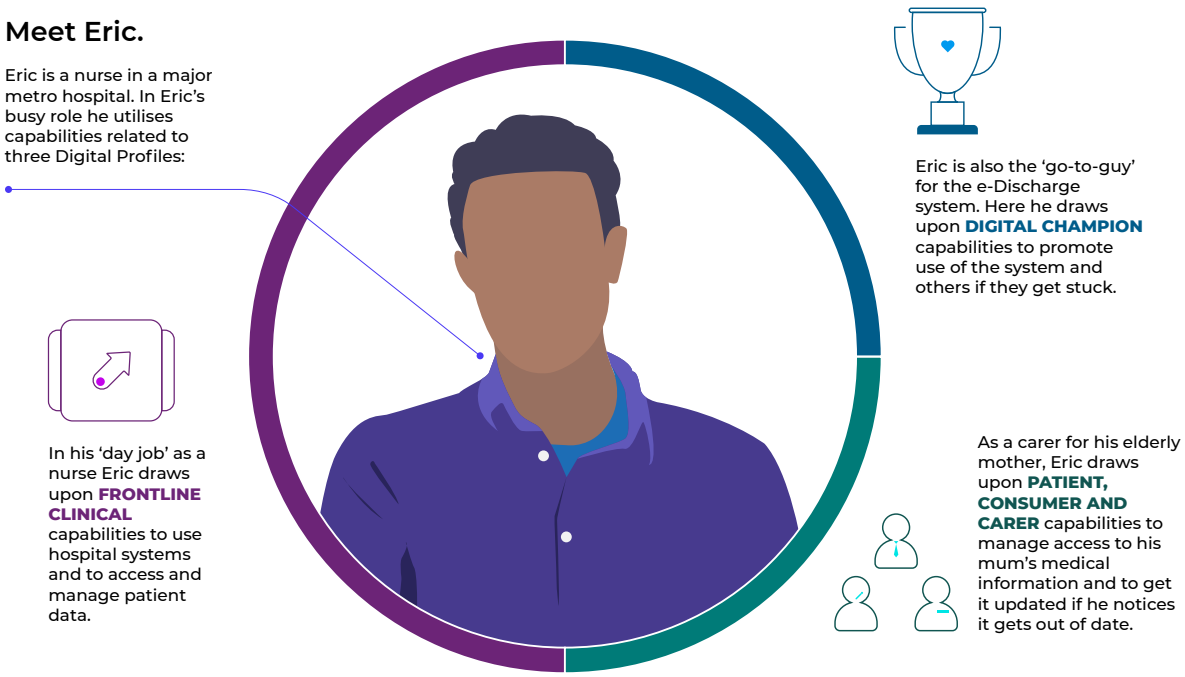
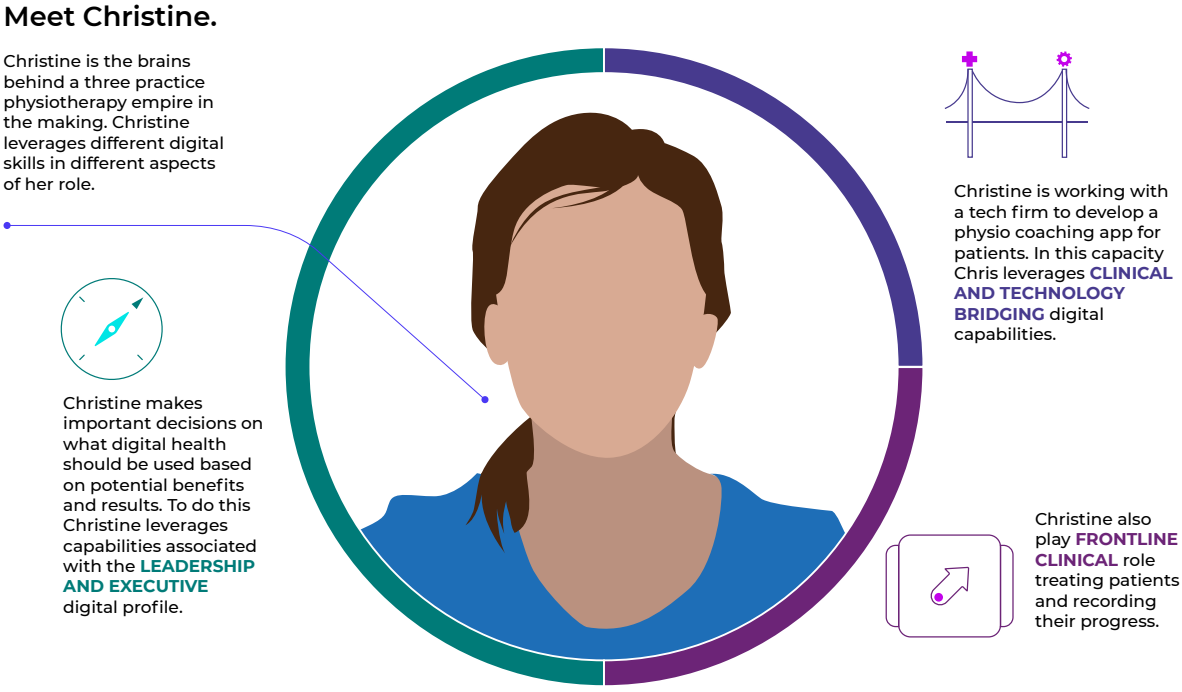


Figure 7: Meet Christine – persona demonstrating how profiles apply to individual's roles



There are distinct expectations associated with each profile. These expectations are catalogued in the following section. Expectations can be grouped into higher order functions such as 'The Quality Record Keeper' or 'The Problem Solver'. The figure below provides an outline of the high-level expectations of each profile and the associated functions.

Figure 8: Key elements of digital profiles

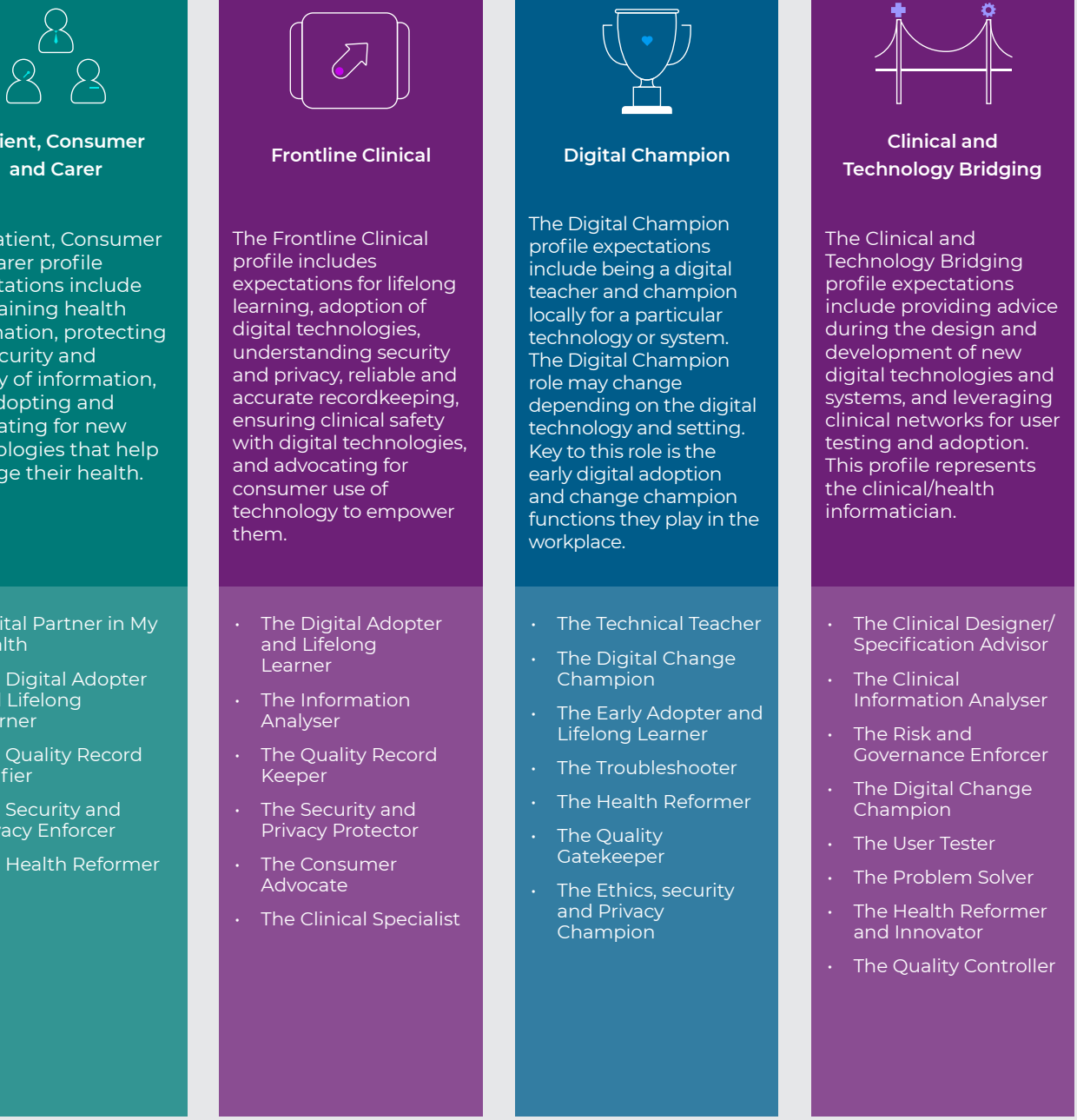
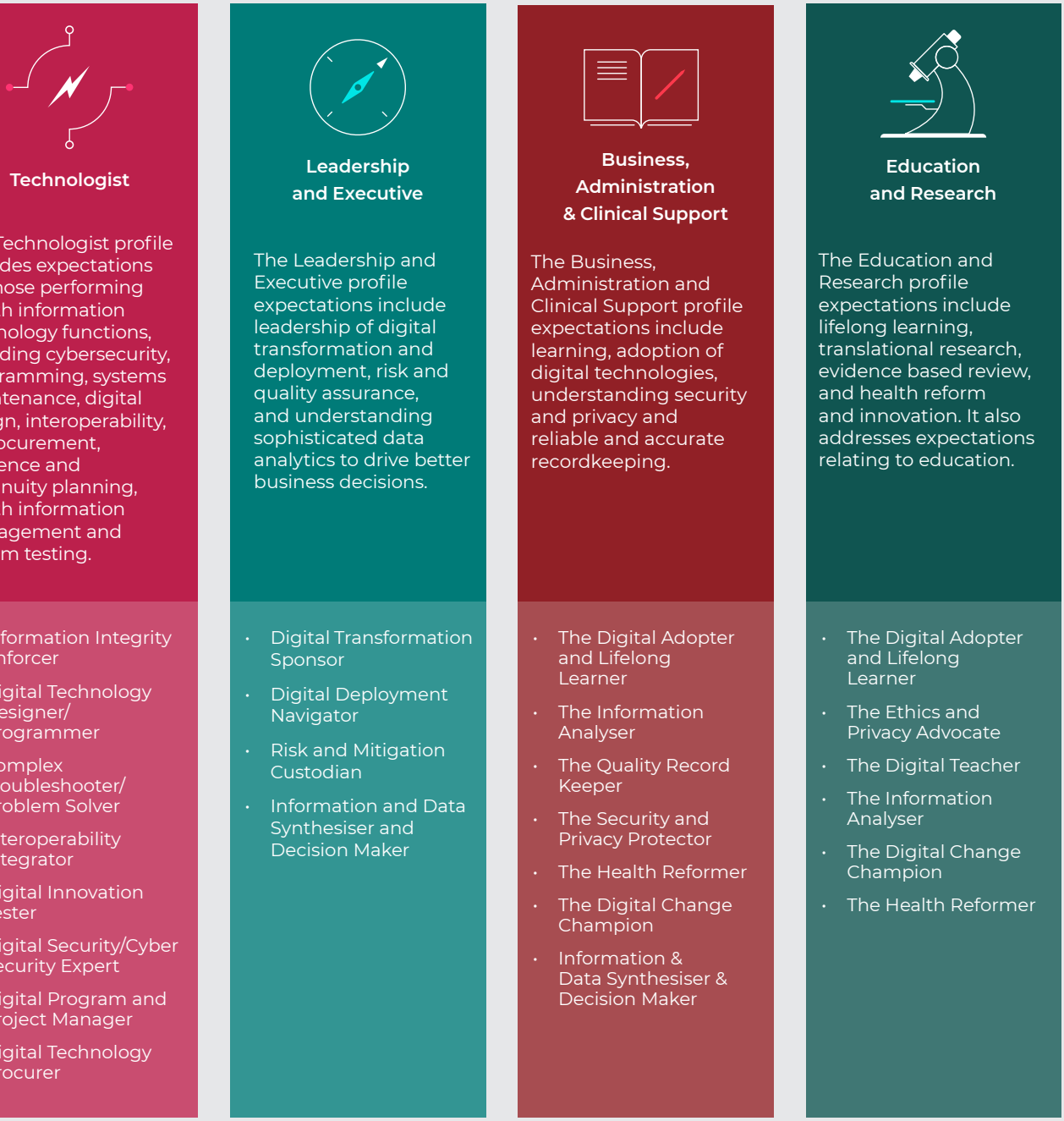


Figure 8 continued: Key elements of digital profiles



The eight digital profiles

DIGITAL PROFILE

Patient, Consumer and Carer

Digital Partner in My Health

- I am able to use digital health to manage and monitor my own health information, understand my risk factors, health conditions and management plans and interact with my health teams to improve my own health outcomes. Through this I will be enabled to spend more time with my health team on treatment and care rather than verifying my information and health history.
- I will utilise digital health to allow me to make informed decisions in relation to my own healthcare including the options available to me.
- I will utilise digital health to better understand my own health in a personalised and tailored way that takes into account my health history, genomics and genetic factors, and environmental and lifestyle factors.

The Digital Adopter and Lifelong Learner

- I have ability to continually adapt to new and emerging digital health, and an understanding of the pace of change.
- I embrace learning as a lifelong activity. I will continue to adopt and learn new technologies relevant to my own health journey to enable improved health outcomes and experiences.
- I understand that the adoption of new digital health may change the way in which tasks were previously undertaken and that this will provide me with greater involvement and information relevant to my own health.

The Quality Record Verifier

- I have the skills and knowledge to play a key role in the creation and verification of the digital health information and data that is kept about me. This includes the ability to create, find, verify, share and maintain digital information in relation to my own health.
- I will challenge information that I don't feel is correct due to its recency, accuracy and completeness. I understand that complete, accurate and current data is important to the management of my health.

The Security and Privacy Protector

- I have the ability to understand and maintain the digital privacy and security on my health data. This includes an understanding of the need for password access, logging out of systems and being aware of the ways in which breaches of information systems may occur.
- I have the ability to seek assistance where suspected breaches of security and / or privacy on digital devices and systems are suspected or confirmed.

The Health Reformer

- I have knowledge of emerging digital health, and an understanding of how digital health can be used to improve health outcomes. This may include advocating for the adoption of new digital technologies in the management of my healthcare.
- I am an advocate for consumer needs and expectations around digital technologies and how they are used in the provision of care.
- I provide feedback in relation to the usability and interoperability of digital devices, technologies, software and applications used in my healthcare and identify improvements.

DIGITAL PROFILE

Frontline Clinical

The Digital Adopter and Lifelong Learner

- I have the ability to continually adapt to new and emerging digital health technologies, and an understanding of the pace of change.
- I am committed to digital learning as a lifelong activity. I engage in continuing professional development including in the area of digital health to enable improved consumer health outcomes and experiences.
- I understand that the adoption of digital health may change the way in which tasks are performed. I am willing to do things differently so that the benefits (to consumers and the health system) can be achieved.

The Information Analyser

- I understand how different digital health technologies might interact, or can be used together, to provide valuable insights and information in relation to the consumer, health events, health experiences and access, efficiency and quality of the health system.
- I have the ability to evaluate and / or interpret data, and data sources to identify misinformation and errors in completeness or accuracy.
- I have the ability to critically analyse large information and data sets to provide deeper insights into the diagnosis, treatment, monitoring and prevention of health conditions.

The Quality Record Keeper

- I have the ability to find, manage, organise, store, share and maintain digital information records and tools relevant to my profession and clinical area. This includes version control, read-only and editable content, and understanding the need to prevent unnecessary duplication of records.
- I have confidence and proficiency in testing information, data and content for accuracy, reliability, recency and completeness.

The Security and Privacy Protector

- I have the ability to understand and adhere to privacy and security requirements and best practices. This includes an understanding of the need for password access, logging out of systems, data privacy and confidentiality, and being aware of the ways in which breaches of information systems may occur.
- I have the ability to seek assistance where suspected breaches of security and / or privacy on digital devices and systems are suspected or confirmed.

The Consumer Advocate

- I have the ability to work with consumers to support their effective, secure, appropriate and innovative use of digital health in order to make better health decisions and achieve successful health outcomes. This may include promoting the use of wearable devices, mobile apps, personalised medicine and digital records.
- I have an understanding of the effect that the digital divide may have on the ability to access and use digital health. I seek to ensure that the services delivered digitally are as inclusive as possible.
- I am an advocate for consumer needs and expectations around digital technologies and how they are used in the provision of care.

The Clinical Specialist

- I understand and utilise digital health technologies that is specific to my clinical role, including understanding how these can be used to enhance the clinical care provided.

DIGITAL PROFILE

Digital Champion

The Technical Teacher

- I have the deep technical knowledge and skills of the particular digital health tool and provide others with advice and assistance.
- I have the ability to teach others the effective, secure, appropriate and innovative use of information, data and content in order to solve problems, make decisions and to achieve successful outcomes for specific goals and objectives.

The Digital Change Champion

- I am a champion for the use of new and innovative digital health technologies that promote effective, secure and efficient use and sharing of information and data.
- I have the ability to support others who may be feeling uncertain, anxious or negative in relation to the digital health technologies.

The Early Adopter and Lifelong Learner

- I actively seek opportunities to learn new technologies, systems and platforms, and an understanding of emerging technologies that may be adopted.
- I have the knowledge and skills to create, access, edit, monitor, store and share health information and understand the digital health technologies relevant to my profession and clinical area.
- I am committed to digital learning as a lifelong activity. I engage in continuing professional development in digital health to enable improved consumer health outcomes and experiences.
- I understand that the adoption of new digital health technologies may change the way tasks are undertaken. I am willing to do things differently so that the benefits (to consumers and the health system) can be achieved.

The Quality Gatekeeper

- I am an advocate for the reliable, timely and comprehensive completion of digital records and information in the workplace.
- I have confidence and proficiency in testing information, data and content for accuracy, reliability, recency and completeness.

The Troubleshooter

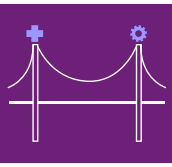
- I have confidence in the diagnosis and remedying of a range of technical challenges and issues independently and / or collaboratively. I have the ability to escalate complex issues to the relevant expert and work closely with the Technologist to facilitate resolution of issues.

The Health Reformer

- I have knowledge of emerging technologies, and an understanding of how technologies can be used to benefit consumers and achieve improved health outcomes. This may include advocating for the adoption of new technologies in my workplace.
- I have the ability to work with consumers to support their effective, secure, appropriate and innovative use of digital health in order to make better health decisions and achieve successful health outcomes. This may include the use of wearable devices, mobile apps, personalised medicine and digital records.
- I have an understanding of the effect that the digital divide may have on the ability to access and use digital health. I seek to ensure that the services delivered digitally are as inclusive as possible.
- I am an advocate for consumer needs and expectations around digital technologies and how they are used in the provision of care.

The Ethics, Security and Privacy Champion

- I have an ability to oversee and maintain quality controls that have been applied to digital health to minimise human error. This includes controls around information privacy and security, system access, mandatory data and information, read-only and editing access, and system integration and interoperability.
- I have the ability to understand and adhere to privacy and security requirements and best practices. This includes an understanding of the need for password access, logging out of systems, data privacy and confidentiality, and being aware of the ways in which breaches of information systems may occur.
- I have the ability to seek assistance where suspected breaches of security and/ or privacy on digital devices and systems are suspected or confirmed.



DIGITAL PROFILE

Clinical and Technology Bridging

The Clinical Design / Specification Advisor

- I provide the clinical requirements around the design and construction of digital health technologies that are either being created or introduced to my organisation, context or setting, and highlight the important of adherence to and management of security principles.
- I understand the clinical information and data that needs to be captured in order to effectively manage the risks and complexity of a person's health needs, diagnosis, treatment, management or future prevention.
- I help to identify improvements that digital health can enable to provide clinicians with more time to focus on clinical care.

The Clinical Information Analyser

- I understand how to integrate data from different digital health technologies, to provide valuable insights and information in relation to the clinical outcomes, health events, health experiences and access, efficiency and quality of the health system.
- I have the ability to evaluate and / or interpret data and data sources to identify misinformation and errors in completeness or accuracy.
- I have the ability to critically analyse large information and data sets to provide deeper insight into the improvement of clinical outcomes, health systems, programs, and health policy.

The Digital Change Champion

- I am a champion for new / innovative digital health technologies that promote effective, secure and efficient use and sharing of information and data.
- I provide the key bridge between the information technology environment and clinical frontline service delivery, sometimes translating "IT speak" into language that my fellow clinicians will understand.
- I am able to provide solutions to solve complex problems relating to a wide range of digital devices, tools, technologies, systems and learning environments.

The User Tester

- I understand how a digital health tool will be used in practice and will act as the user tester to ensure it will be fit for purpose.
- I leverage my strong clinical networks to provide key clinical input and user testing advice throughout the development of the technology.

The Risk and Governance Enforcer

- I understand where digital health should be providing alerts to users because the clinical data and information suggest a significant risk to the consumer's health.
- I provide advice on and understand who should have clinical governance responsibility and accountability over certain systems because of their specific role, knowledge and skills.
- I understand the different system access user roles from a clinical perspective in relation to a person's health needs, diagnosis, treatment, management or future prevention.

The Health Reformer and Innovator

- I have knowledge of emerging technologies, and understanding of how technologies can be used to benefit consumers and achieve improved health outcomes. This may include advocating for the adoption of new technologies in my workplace.
- I identify where technologies and solutions could be utilised in order to drive improved health outcomes and benefits to the consumer and / or free capacity across the clinical health workforce.
- I have an understanding of the effect that the digital divide may have on the ability to access and use digital health. I seek to ensure that the services delivered digitally are as inclusive as possible.
- I am an advocate for consumer needs and expectations around technologies and how they are used in the provision of care.

The Quality Controller

- I provide leadership and guidance to others on the accuracy and reliability of the information and data for which they are responsible.
- I am an advocate for the reliable, timely and comprehensive completion of digital records and information in the workplace.
- I have confidence and proficiency in testing information, data and content for accuracy, reliability, recency and completeness.
- I understand the implications of change and the need to adhere to technical design guidance of my organisation and acknowledge the need for appropriate sponsorship and sustainment investments in digital systems to ensure they are well maintained and do not fall outside of system lifecycle requirements.

DIGITAL PROFILE

Technologist

Information Integrity Enforcer

- I ensure the information integrity of digital health by ensuring that security and controls are in place. A key part of this is ensuring technical quality assurance and compliance with quality and information management standards. I ensure information and data from legacy systems is still able to be accessed and utilised as required to ensure historical information is not lost.
- I provide leadership and training on the use, editing, storage and sharing of information and data across digital devices and systems.
- I have deep knowledge and implement local policies and structures in order to meet relevant legislation, guidelines, policies and protocols (including around areas including copyright, information privacy and confidentiality, information security).
- I am able to restrict information access as appropriate to the technology in a way that upholds requirements around information privacy and quality of record keeping whilst supporting its effective use for the health workforce.

Digital Technology Designer/Programmer

- I design, construct, evaluate and modify digital health technologies (including IT systems and physical devices) to meet clinical and consumer requirements.
- I liaise closely with the Clinical and Technology Bridging Digital Profile to understand the clinical information and data that needs to be captured in order to effectively manage the risks and complexity of a person's health needs, diagnosis, treatment, management or future prevention.
- I help to identify improvements that digital health can enable to best meet user needs.
- I identify where technologies and solutions could be utilised in order to drive improved health outcomes and benefits to the consumer and /or free capacity across the clinical health workforce.

Complex Troubleshooter/Problem Solver

- I am able to troubleshoot complex problems and issues as they arise in relation to digital health through my deep knowledge and understanding of the way digital devices, technologies, software and applications operate.
- I am able to navigate health services networks and ensure reliability, redundancy and availability.

Interoperability Integrator

- I understand the different technologies and systems that have been adopted in my workplace and understand how to promote their interoperability to ensure the advantages of integrated information systems can be effectively leveraged. In doing this I may identify further opportunities for information systems integration and interoperability.

Digital Innovation Tester

- I am able to test digital health to ensure it is fit for purpose. This may include testing off the shelf and bespoke functionality. Key to this is understanding how these technologies will be utilised in practice, including how they may change current functions and processes and achieve intended benefits.

Security/ Cyber Security Expert

- I provide specialist advice in relation to cyber security and play a key role in ensuring the privacy and security of confidential personal information. A key aspect of this is understanding information security risks to digital health and putting in place mechanisms that prevent or minimise the damage caused by security breaches.

Digital Program and Project Manager

- I provide project and program management and coordination of digital health projects and programs of work including management of their day-to day operations and deployment of new technologies.
- I am a champion for new / innovative technologies and work closely with my clinical colleagues to promote effective, secure and efficient use and sharing of information, data and content.

Digital Technology Procurer

- I manage the procurement of digital health technologies including the initial supply of, and ongoing management and support provided to these technologies. Key to this is an awareness of available options in the market and what would best align to the needs of my organisation, taking into account functionality, deployability, interoperability and previous client experiences.

DIGITAL PROFILE

Leadership and Executive

Digital Transformation Sponsor

- I enable and lead the health workforce to successfully implement and adopt new technologies and new ways of working, including the change management, culture and leadership required for this to succeed.
- I address change resistance and will work with all stakeholders to resolve legitimate issues and achieve acceptance, commitment and advocacy.
- I communicate a compelling vision and rationale for digital health reform in a health context, including engaging with others to work collaboratively to achieve real change.
- I encourage a culture of digital mindsets (including lifelong learning) across the workforce to support the implementation of digital health.
- I nurture and build workforce capabilities in digital health across the workforce to ensure the effective implementation of digital health.

Digital Deployment Navigator

- I provide the sponsorship for the deployment of new and innovative digital health technologies. This includes providing strategic leadership to the professionals that are involved in the program and project management and change management of these technologies.
- I identify, prioritise and approve the new and innovative technologies that will be implemented and adopted in my organisation. As part of this I ensure alignment with other strategic priorities and consider constraints such as resourcing, budget, risk and timeframes.
- I navigate the digital landscape (including devices, technologies, software and applications) and identify those that offer the best opportunities for improved consumer and health system outcomes.

Risk and Mitigation Custodian

- I am able to anticipate, identify and address risks to digital service delivery and ensure the ongoing safety and wellbeing of consumers and the health workforce.
- I lead health information technologists in ensuring that risks (including cybersecurity) are effectively managed and tested prior to the deployment of new digital health technologies, and through the ongoing maintenance of systems.
- I monitor the progress and achievement of intended benefits of digital health to ensure that they are achieved, and through this process overcome any barriers to success.
- I am the champion of Cyber Security at the Board Level and continue to advocate to the health workforce the importance of contemporised education that contemplates organisational cyber security obligations. I understand the ramifications of not being able to meet the cyber security obligations of healthcare organisations locally and globally.

Information and Data Synthesiser and Decision Maker

- I use advanced data and information analytics from digital health to make informed, and where appropriate real-time, business decisions. I draw together the strategic insights from data to understand trends, patterns, issues and opportunities.
- I lead the improvement of data quality, recency, reliability, interoperability across the digital landscape.

DIGITAL PROFILE

Business, Administration and Clinical Support

The Digital Adopter and Lifelong Learner

- I have the ability to continually adapt to new and emerging digital health technologies, and an understanding of the pace of change.
- I have the knowledge and skills to create, access, edit, monitor, store and share health information and understand the health systems and digital tools relevant to my profession and clinical area.
- I am committed to digital learning as a lifelong activity. I engage in continuing professional development including in the area of digital health to enable improved consumer health outcomes and experiences as I undertake in my business, administrative or clinical support role.
- I understand that the adoption of new technologies may change the way in which tasks are performed. I am willing to do things differently so that the benefits (to consumers and the health system) can be achieved.

The Information Analyser

- I understand how different digital health technologies might interact, or can be used together, to provide valuable insights and information in relation to the consumer, health events, health experiences and access, efficiency and quality of the health system.
- I have the ability to evaluate and /or interpret data and data sources to identify misinformation and errors in completeness or accuracy.
- I have the ability to critically analyse large information and data sets to provide deeper insight into the improvement of health systems, programs, policy and business operations.

The Quality Record Keeper

- I have the ability to find, manage, organise, store, share and maintain digital information and data. This includes version control, read-only and editable content, and understanding the need to prevent unnecessary duplication of records.
- I have confidence and proficiency in testing information, data and content for accuracy, reliability, recency and completeness.

The Security and Privacy Protector

- I have the ability to understand and adhere to privacy and security requirements and best practice. This includes an understanding of the need for password access, logging out of systems, data privacy and confidentiality, and being aware of the ways in which breaches of information systems may occur.
- I have the ability to seek assistance where suspected breaches of security and/ or privacy on digital devices and systems are suspected or confirmed.

The Health Reformer

- I have knowledge of emerging technologies, and an understanding of how technologies can be used to benefit consumers and achieve improved health outcomes. This may include advocating for the adoption of new technologies in my workplace.

The Digital Change Champion

- I am a champion for new / innovative digital health technologies that promote effective, secure and efficient use and sharing of information and data.
- I have the ability to support others who may be feeling uncertain, anxious or negative in relation to the new digital health technology.

Information and Data Synthesiser and Decision Maker

- I use advanced data and information analytics from digital health technologies to make informed, and where appropriate real-time, business decisions. I draw together the strategic insights from data to understand trends, patterns, issues and opportunities.
- I implement programs to drive improvement of data and information quality, recency, reliability, interoperability. This may include by making data and information more accessible to other system users including through reports, dashboards and other tools.

DIGITAL PROFILE

Education and Research

The Digital Adopter and Lifelong Learner

- I have the ability to continually adapt to new and emerging digital health technologies, and an understanding of the pace of change.
- I have the knowledge and skills to create, access, edit, monitor, store and share health information and understand the health systems and digital tools relevant to my research and teaching area.
- I am committed to digital learning as a lifelong activity. I engage in continuing professional development, including in the area of digital health, to ensure I adopt contemporary and evidence based digital approaches in my teaching and research.
- I understand that the adoption of new digital health technologies may change the way in which tasks are performed. I am willing to promote and teach new approaches to health service delivery so that the benefits (to consumers and the health system) can be achieved.

The Digital Teacher

- I draw on my contemporary digital health research to develop educational resources and activities to support the learning and teaching of myself and others. I am aware of international research and contemporary and emerging practice in relation to digital health.
- I am able to champion a positive attitude towards innovative technologies and use this to enhance the learning experience for myself and others.
- I draw on a multi-faceted approach to teaching and learning in relation to digital health to ensure that I am maximising the impact I have on others who are seeking to develop their own knowledge, skills and behaviours in relation to digital health.
- I champion equitable access for all in relation to digital teaching, learning and self development, and promote digital avenues that support the skilling of the workforce in rural and remote areas of Australia.

The Digital Change Champion

- I am a champion for new / innovative digital health and developing the evidence base to support the adoption of these technologies into practice.
- I have the ability to support others who may be feeling uncertain, anxious or negative in relation to new and emerging digital health technologies.

The Ethics and Privacy Advocate

- I understand and adhere to privacy and security requirements in relation to the digital health research I undertake. This includes the de-identification of personal information, and the confidentiality and privacy of participants in research.
- I advocate and enforce ethical practices and constraints in relation to my digital health research. This includes through ethical principles of self-determination, beneficence, non-maleficence and justice.
- I have confidence and proficiency in testing information, data and content for accuracy, reliability, recency and completeness and utilise this in my research and teaching.

The Information Analyser

- I understand how different technologies might interact, or can be used together, to provide valuable insights and information in relation to the consumer, health events, health experiences and access, efficiency and quality of the health system.
- I have the ability to bring together qualitative and quantitative information to evaluate the impact of digital health at an individual, group and/or population level.
- I have the ability to critically analyse large information and data sets to provide deeper insight into the improvement of health systems, programs, policy and business operations.

The Clinical Specialist

- I have knowledge of emerging technologies, and an understanding of how technologies can be used to benefit consumers and achieve improved health outcomes. This may include advocating for the adoption of new technologies in my workplace, in education and teaching practices and/or for a particular profession/ speciality or emerging role.
- I promote translational research in relation to digital health to ensure that the evidence based practice and academic innovation are translated to changes at the bedside that lead to demonstrated improved outcomes for consumers.

4.8 Health education priorities

The expectations identified in the digital profiles can serve as a reference point when planning workforce digital literacy education to promote the safe, ethical and efficient use of systems of record. Digital literacy capability uplift should, where possible, be integrated into existing curricula (rather than standing alone). Change leadership will be required to support the take-up of education opportunities and to embed new ways of working into health organisations.

An initial view of the digital literacy capability uplift interventions that will be required for each digital profile is summarised in Figure 9. These interventions, and the actions identified by participants in the National Digital Health Workforce and Education Summit (the summit), should serve as a starting point for the development of the Capability Action Plan (CAP) and the development of specific targets and measures by which to track progress.

Educational opportunities are required for both the existing health workforce and future employees preparing for work in the sector. The digital literacy needs of consumers, carers and volunteers within the sector must also be addressed[93]. The Widening Digital Participation programme from the UK provides a contemporary example of a digital literacy program designed to support consumers with lower levels of digital literacy

Case study: Widening Digital Participation programme, UK:

Run by the Good Things Foundation and funded by NHS Digital, the program aims to reduce digital exclusion in the UK, with a focus on addressing the digital health literacy of 'digitally excluded people'.

The program is being run over six years with the initial focus to identify the consumer cohorts of greatest needs and to better understand the challenges faced by these cohorts. Phase 1, completed between 2013 and 2016, delivered training to more than 200,000 people, with the goal of improving their digital health literacy.

Phase 2 of the program, being delivered between 2017 and 2020, is focusing on developing and piloting user-centred approaches to addressing digital exclusion and addressing the digital divide at a system-wide level by working with the commissioners and designers of digital health services. It also includes the development of a set of digital learning products to raise awareness about digital technologies.[97]

Phase 2 is piloting 20 different ways to embed digital inclusion into healthcare over 12 months. One example of these pilots is the Seaview Project, a homeless charity in Hastings, which has engaged more than 600 people and has recruited more than 30 digital champions[98]. The Seaview Project has tested two models to improve the use of digital technology to support access to health information. These are:

- Using technology to record and triage health concerns for rough sleepers; and
- Supporting people who visit the wellbeing centre and other public spaces to use the internet to access health information.

Each digital profile will require a different mix of education, training and support to achieve digital health literacy. This will require a partnership approach involving stakeholders from across the sector. A key example of different health stakeholders (from industry, education and training) working together to improve digital literacy for the health workforce in NSW is provided below.

Case study: massive open online course (MOOC), NSW Health and Sydney University:

NSW Health, the University of Sydney and the Digital Health CRC have partnered to deliver a new MOOC. The MOOC explores how digital health is transforming health service delivery in clinical practice and the potential of data use in healthcare. The MOOC has been developed in alignment with the eHealth Capability Framework, which outlines foundation-level expectations for health graduates and the workforce including clinical and non-clinical staff, as outlined in the NSW Health Analytics Framework[99].

All members of the existing and future health workforce are eligible to access this new foundational curriculum, which eHealth NSW developed in collaboration with the University of Sydney and NSW Health's Health Education and Training Institute (HETI).

The MOOC supports learners to understand the emerging role of data in decision-making, evidence-based practice and quality patient care, with more than 30 videos and associated learning resources in 12 to 25 hours of self-directed learning, over an estimated four to five weeks[100].

Ethical issues have also been arising through the greater use of digital health solutions. Confident and beneficial use of such technologies must be underpinned by appropriate ethical frameworks. These frameworks should address digital health issues broadly, considering for example cultural safety, rather than focusing narrowly on technologies. Good frameworks will guide decisions ranging from the management of an individual patient's data through to the design of the algorithms used to support aggregation of data and decision making.

Figure 9: Education and training interventions for digital profiles across Horizon 1.

Patient, Consumer and Carer	Frontline Clinical	Digital Champion	Clinical and Technology Bridging
Digital Expectations (Workforce Focus)			
• The Health Reformer • The Digital Adopter and Lifelong Leaner • The Security and Privacy Protector • Digital Partner in My Health • The Quality Record Verifier	• The Digital Adopter and Lifelong Learner • The Information Analyser • The Clinical Specialist • The Security and Privacy Protector • The Quality Record Keeper • The Consumer Advocate	• The Technical Teacher • The Health Reformer • The Ethics, Security and Privacy Champion • The Troubleshooter • The Early Adopter and Lifelong Learner • The Quality Gatekeeper • The Digital Change Champion	• The Clinical Design/ Specification Advisor • The Clinical Information Analyser • The Health Reformer and Innovator • The Risk and Governance Enforcer • The Problem Solver • The User Tester • The Digital Change Champion • The Quality Controller
Digital Literacy Capability Uplift Interventions (Education Focus)			
• Programs that focus on supporting the digital literacy of the most vulnerable stakeholders. • Greater consideration given to the support for consumers in the adoption of digital health in their healthcare (potentially through MOOCs, or embedding technology supports in local support programs (e.g. diabetes management). • Establishment of consumer communities of practice to build local capability and provide a voice.	• Integration within all health undergraduate curricula and VET curricula (health training package). • Available modules or subjects for those already in the health workforce (and alignment to continuing professional development). • Education and industry partnerships to ensure that the digital capabilities reflect the rate and pace of technological change in health. • Changing digital mindset to support lifelong learning and adoption of new technologies.	In addition to what is in the frontline clinical workforce: • Change advocacy training and support to help drive digital transformation. • Changing digital mindset to acknowledge early adoption and curiosity for digital health. • Targeted training around process redesign and operational improvement given where the largest opportunities to drive transformation are expected in health.	A clear career pathway, including: • A recognised, evidence based and leading course that is recognised by health professionals. • Recognition from professional associations and Boards around the value of this role in each profession (registered and self-regulated). • Credentialing of relevant courses to provide for this; • Specialist training pathways that recognise this.
Underpinning all Digital Profiles			
Digital governance, ethical frameworks, quality and safety checks and what to do in the case of system failure for each specific technology introduced in a speciality area. It should be noted that some will invite greater ethical considerations than others. It is also expected that such frameworks will start to be developed at an international or World Health Organisation level. Increased consideration and use of micro-credentialing. Introduction of workplace specific education and training that reflect on-the-job requirements and local processes.			

Technologist	Leadership and Executive	Business, Administration & Clinical Support	Education and Research
Digital Expectations (Workforce Focus)			
• Information Integrity Enforcer • Digital Technology Designer/ Programmer • Digital Technology Procurer • Digital Innovation Tester • Interoperability Integrator • Security/ Cyber Security Expert • Complex Troubleshooter/ Problem Solver • Digital Program and Project Manager	• Digital Transformation Sponsor • Information and Data Synthesiser and Decision Maker • Digital Deployment Navigator • Risk and Mitigation Custodian	• The Digital Adopter and Lifelong Learner • The Information Analyser • The Security and Privacy Protector • The Quality Record Keeper • The Digital Change Champion • The Health Reformer • Information and Data Synthesiser and Decision Maker	• The Digital Adopter and Lifelong Learner • The Ethics and Privacy Advocate • The Digital Teacher • The Information Analyser • The Digital Change Champion • The Health Reformer
Digital Literacy Capability Uplift Interventions (Education Focus)			
• A greater emphasis on the consumer bedside/ context in the development of digital technologies- to allow for true transformation of what is both wanted and needed. • Consideration of the new roles that will be created in this area in the coming decade (specialist IT roles for example personalised medicine, cyber-legal, genomics). • Increasing recognition of the current courses/ certifications that ensure that the information technology workforce is able to use their skills in the health context (e.g. CHIA). • Greater recognition of a generalist role needed to support small/ medium health organisations who may not be a specialist but will need to support all facets of new digital systems.	• Programs that focus on the digital literacy, and strategic knowledge required at an executive, senior leadership and Board level. This may include decision making, risk, and governance around IT systems, implementation and change management. • Programs that focus on transformational change, including navigating the workforce through changes to tasks and functions. • Programs that support strategic analysis and insights from digital systems to drive system change.	• Changing digital mindset to support lifelong learning and adoption of new technologies. • Targeted training around process redesign and operational improvement given where the largest opportunities to drive transformation are expected in health. • Integration within all business and admin curricula and VET curricula (noting its wider application across business/finance industry). • Available modules or subjects for those already in the health workforce (noting that there may need to be a re/up-skilling of some roles that may not be required into the future).	• Change advocacy training and support to help drive digital transformation. • Changing digital mindset to acknowledge early adoption and curiosity for digital health. • Programs that focus on transformational change, including navigating the workforce through changes to tasks and functions. • A greater emphasis on the consumer bedside/ context in the development of digital technologies- to allow for true transformation of what is both wanted and needed.

Underpinning all Digital Profiles

Digital governance, ethical frameworks, quality and safety checks and what to do in the case of system failure for each specific technology introduced in a speciality area. It should be noted that some will invite greater ethical considerations than others. It is also expected that such frameworks will start to be developed at an international or World Health Organisation level. Increased consideration and use of micro-credentialing. Introduction of workplace specific education and training that reflect on-the-job requirements and local processes.

Horizon 2:
Integrating new technologies and ways of working

4.9 Vision

Organisations and the digital health systems they use are better connected through interoperability and secure messaging, streamlining information flows. This enables them to analyse information, plan, and respond to health demands.

Many emerging technologies are expected to be adopted in health and across the wider economy over the coming years. The adoption of these technologies (including AI, genomics, advanced robotics, the IoT, and 3D printing) is expected to accelerate over the coming years. Often referred as the 'fourth industrial revolution', these technologies are expected to significantly impact on ways of working across the health workforce through automation, augmentation and providing novel capabilities. The focus of Horizon 2 is on driving the deployment and integration of these new technologies in the health context.

To deliver benefits, new technologies need to be supported by new ways of working. New roles, and changes to existing roles will emerge. Some segments of the health system, such as community pharmacy[101], are actively considering these changes and the opportunities they present. People play an integral role in the delivery of healthcare and will continue to do so in the future. New ways of working must therefore be introduced in a way that supports and recognises the contribution of all staff within the health sector.

4.10 Potential benefits and outcomes

Horizon 2 will establish better connections between systems and organisations to enable information analysis, planning and proactive responses to health demands (for example through interoperability), and improve the ability to diagnose, treat and manage health conditions (for example through AI, 3D printing, and advanced robotics).

A number of digital health innovations are already being deployed in pockets across the health workforce. Work will be required to promote adoption and uptake of digital health and better practices to realise system-wide benefits. Interoperability, wearables, genomics, AI and robotic surgery are a few of the current innovations that have been deployed or are in development either in Australia or internationally. Other digital health innovations are likely to emerge in the near future.

Examples of technologies:

- Interoperability – the ability of different information systems, devices or applications to connect, in a coordinated manner, within and across organisational boundaries to access, exchange and cooperatively use data among stakeholders, with the goal of optimising the health of individuals and populations.
- Robotic surgery – minimally invasive surgery involving the use of a computer to control surgical instruments attached to robotic arms.
- Artificial intelligence – systems that replicate features of human intelligence to enable intelligent behaviour by machines for a specific purpose or 'narrow AI'.
- Next generation genomics – study of genes and their functions enables technologies (such as massive parallel sequencing and human genome sequencing) that support diagnostic tests and therapies.
- Wearables – wearable technologies such as blood glucose monitors with the ability to automatically upload data to the health record.
- 3D printing – additive printing processes used to make exact copies of goods (in a health context this may include prosthetics, medical devices and even skin).

The technologies that align to Horizon 2 are expected to deliver significant benefits to both patients and health professionals. These include:

- Interoperability enables clinician decision making by providing access to patient-clinical information from a range of sources;
- Streamlined information minimises duplicate data entry. This produces efficiencies for the frontline clinical and administrative roles;
- Reduced manual data entry and increased use of technology in health information management will decrease variability (including that resulting from human error), and improve semantic interoperability;
- Advanced robotics is used in surgery for less invasive treatment, with faster recovery and improved health outcomes;
- Genomics improves the early diagnosis and/or likelihood of specific diseases or illness;
- AI enables more accurate diagnosis of disease. For example, cancer diagnosis in radiology and dermatology; and
- 3D printing and bioprinting creates bespoke medical devices and assistive technologies for each individual which will help to reduce rates of implant rejection and improve treatment and recovery times.

4.11 Workplace changes

A range of technologies are expected to automate and augment roles. New technologies, including for example process automation, robotics and predictive analysis, are predicted to have a significant impact across the healthcare sector. In addition, cognitive automation, natural language processing, machine learning and AI are anticipated to provide the opportunity for the health sector to achieve efficiencies by automating routine and repetitive tasks[102].

Specific digital health technologies will reshape health functions and professions in very different ways. For example, robotics and automated image interpretation using AI may impact on the functions and ways of working for surgeons[103]. Precision medicine, the use of AI-enabled apps and secure messaging may be of greater importance to general practice physicians. A nuanced view of what is occurring across specific health professions and specialties will therefore be required to understand workplace changes in Horizon 2.

Predicting these changes with certainty is not possible. However, it is possible to identify those parts of the health sector most amenable to the application of digital technologies. To do so requires an understanding of the nature of the work performed across the sector and a view on the current and emerging capabilities of digital technologies. Faethm is a platform which uses analytics and machine learning to support this type of analysis. The following "Faethm Projections" section presents a glimpse into the future based on analysis performed on that platform. This view of the opportunities for the application of technologies in the sector may inform strategy development and help to identify promising digital health investments.

Faethm: glimpse into the future

The analysis approach

The Faethm platform and database can be used to predict technologies expected to impact the workforce based on the human abilities they disrupt or enhance. This process involves three distinct data sets:

- ***Workforce Population Data:*** details of the size and composition of the workforce in question. In this analysis a subset of Australian Bureau of Statistics 2016 census data has been used as a baseline.
- ***Work Task and Capabilities Data:*** the Faethm database includes 264 general work tasks (linked to 20,000 specific O*NET[ii] tasks). Each work task is described by a selection of human abilities required to complete the task.
- ***Technology Capability Data:*** the Faethm database also tracks the current and projected capabilities of 17 distinct types of digital technology. This tracking links specific digital technologies to specific work tasks.

Faethm uses AI to map workforce population data to designated jobs and general work tasks. Technology capability data can then be applied to model the potential of a given technology to automate or augment aspects of the work performed by the workforce population.

ii. The Occupational Information Network (O*NET) is a free online database that contains hundreds of occupational definitions to help students, job seekers, businesses and workforce development professionals to understand today's world of work in the United States: https://www.onetcenter.org/overview.html

Table 3: Faethm technology types

Faethm Cluster	Technology types
Programmed intelligence	Process automation, fixed robotics, mobile robotics.
Narrow AI	Predictive analysis, recognition vision, suggestion provision, voice response.
Broad AI	Decision generation, sensory perception, conversation exchange, dexterous robotics.
Reinforced AI	Assistive robotics, navigation robotics, collaborative robotics, generative design, solution discovery, creative origination.

Analysis of the Australian health workforce

Faethm analysis predicts that over the next ten years, 28.5% of health workforce roles can potentially be augmented by digital technologies. For individuals in these roles digital technology may replace manual processes or make tasks easier allowing them to work more effectively. If fully realised, Faethm projects that these increases in efficiency could equate to 12.2% capacity gain across the health workforce. The analysis also indicates significant potential to automate (and replace entirely) roles focused on routine rules-bound processes such as manual transcription of records from one system to another or workflow and scheduling tasks. This potential must be considered in the context of the investments required to realise digital health, the lead time for realising benefits, and the costs of operating new technologies.

The potential of digital health predicted by Faethm differs significantly between clinical and non-clinical roles. Opportunities also differ between areas of the health system. The following sections look at projections for clinical and non-clinical opportunities across the following segments of the health workforce[iii]:

- Allied health;
- Hospitals;
- Primary health;
- Specialist health; and
- Aged care services.

iii. Appendix D provides a breakdown of how Australian Bureau of Statistics Census data has been mapped to these health workforce segments for the purpose of Faethm analysis.

Clinical potential

Clinical opportunities differ across segments of the health workforce due to differences in the nature of the work performed. The heat map below identifies the top five digital technologies across health sector segments based on Faethm analysis of opportunities over the next ten years. Three technologies (process automation, sensory perception and suggestion provision) feature consistently across the health areas segments.

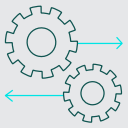
Table 4: Clinical potential of digital technology by health sector segment

Allied health	Hospitals	Primary health	Residential aged care	Specialist health
Process automation	Process automation	Suggested provision	Process automation	Suggested provision
Fixed robotics	Sensory perception	Process automation	Sensory perception	Process automation
Sensory perception	Generative design	Sensory perception	Generative design	Sensory perception
Solution discovery	Suggested provision	Generative design	Voice response	Sensory perception
Navigation robotics	Predictive analysis	Predictive analysis	Assistive robotics	Predictive analysis

Key: Higher Potential — *Relative to other clinical opportunities* — *Lower Potential*

The following case studies provide further details on a selection of key digital technologies and their potential impact on healthcare delivery.

Key digital technology: process automation



What is it?

Process automation is defined as technologies programmed to complete predefined, logical and rule-based processing tasks such as quantitative calculations, process onboarding, monitoring and simple robotic jobs and movements. This works by applying rule-based logic to take structured inputs and using predefined executable steps, deliver structured outputs.

Health applications

Hospitals are highly process driven environments. From admission to discharge, patients follow numerous processes many of which can potentially be augmented with automation to reduce the time taken to perform low value tasks. Admission and discharge processes can involve large amounts of data collection and consolidation, and production and distribution of documentation. Collection of admission data, generation of forms and charts, quality assurance of data, and generation of reminders and letters are all examples of processes that clinical and non-clinical health workers can benefit from using. Key to the successful use of this technology is the input of accurate data and the ability to read and understand data outputs in different formats.

Key digital technology: sensory perception

What is it?

Sensory perception technologies are systems that use sensors to detect and extract meaning from external stimuli and use this as a prompt to an action. This works by using sensors in combination with machine learning to detect and respond to specific external parameters such as information sources and interactions.

Health applications

Aged care facilities are exploring the uses of ambient sensor technologies to detect changes in behaviour and potential issues. Aged care provider RSL LifeCare opened a new facility in 2017 featuring a number of innovative technologies including laser beams, sensors and a robot that looks like a baby harp seal[104].

The technologies employed can prevent falls, monitor residents' locations and activities and set off alarms when urgent care is required. One of the benefits of ambient sensor technology is that it is not invasive and does not require aged care residents to learn to use new digital health technologies.

Sleeptite is an Australian company pioneering ambient sensor technology designed to monitor and provide "real-time health and wellbeing information of residents in order to improve care outcomes and workflow" . Sleeptite are "currently developing flexible proximity sensors embedded in bedding material that will offer real-time feedback on a user's state of health and sleep. This system will revolutionise the current Australian health care sector through a non-invasive, medical grade monitoring system". Development plans include additional sensors capable of monitoring breathing and hydration.

Key digital technology: suggestion provision

What is it?

Suggestion provision technologies are tools that reactively prioritise and rank data to identify relevant recommendations for specific parameters and goals. This works by filtering data, using machine learning and specific parameters of a problem, distinguishing and ranking outcomes to provide estimated solutions.

Health applications

One example of this type of technology are databases such as 'Modernizing Medicine[106]'. This is a web-based repository of medical information and insights to provide medical specialists with data, information and suggestions that they otherwise would not have available to them. Modernizing Medicine mines data and delivers clinical decision support to medical specialists. This is made possible through its use of IBM Watson and Watson's ability to quickly query and identify relevant information contained in thousands of medical journals, research studies and other documents.

Modernizing Medicine was first made available to dermatologists. In practice, this technology provides an interface into which a dermatologist can ask questions in natural language about possible symptoms and treatments. Within seconds the technology will provide an informed, evidence-based response.

Reliance on technologies such as this require a cultural shift and changes to ways of working that include use of web-based tools. Healthcare providers need to be able to trust the source of data and use a search engine efficiently and effectively.

Non-clinical potential

Non-clinical opportunities also differ across segments of the health workforce due to differences in the nature of the work performed. The heat map below identifies the top five digital technologies across health sector segments based on Faethm analysis of non-clinical opportunities over the next ten years. Process automation and suggestion provision feature strongly. The application of process automation in hospitals for non-clinical roles may include for example the automation of reminder letters and invoices. Another technology that is indicated to have an impact on non-clinical roles across the health areas is predictive analytics.

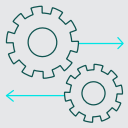
Table 5: Non-clinical potential of digital technology by health sector segment

Allied health	Hospitals	Primary health	Residential aged care	Specialist health
Predictive analysis	Process automation	Predictive analysis	Suggestion provision	Predictive analysis
Process automation	Suggestion provision	Assistive robotics	Process automation	Suggestion provision
Suggestion provision	Predictive analysis	Suggestion provision	Predictive analysis	Process automation
Assistive robotics	Navigation robotics	Process automation	Navigation robotics	Assistive robotics
Decision generation	Solution discovery	Decision generation	Mobile robotics	Decision generation

Key: *Higher Potential* *Relative to other non-clinical opportunities* *Lower Potential*

The following case studies provides further details on a selection of key technologies and their potential impact on healthcare delivery.

Key digital technology: predictive analysis



What is it?

Predictive analytic technologies are tools that use algorithmic-based process and prediction software to evaluate historical and real-time data, extracting relevant information and making predictions about the future. Predictive analysis is capable of searching through very large and varied sources of data and analysing them to predict outcomes for individual patients.

Health applications

Predictive analysis allows for the improvement of operational efficiency[107]. For example, this technology can be used to examine historical data, overflow data from nearby facilities, population data, demographic data, reportable diseases, and seasonal sickness patterns to predict ebb and flow. This provides the opportunity for managers to then plan for when extra staff or beds may be required and to optimise patient-to-staff ratios and prevent bed shortages.

Another example describes how predictive analytics can be utilised to indicate the risk profile of aged care services by measuring facility data such as pressure injuries, staff-to-patient ratios, qualified staff, wages, patient turnover, and profitability statistics. Benchmarking this data across the sector creates a risk profile. Administrators with access to this information need the skills and capabilities to interpret the data and identify anomalies. They need to have the skills to work together with medical staff to undertake a root cause analysis and to design an appropriate response to rectify any issues identified.

4.12 Workforce and capability requirements

A nuanced view of the impact on functions and tasks for each health profession and speciality

With the emergence of new technologies, it is clear that the current skills and capabilities of the health workforce will need to shift. In the UK, it is predicted that in the next 20 years, 90 per cent of jobs in the health sector will require digital skills[108]. However, there will be substantial differences across roles, professions and specialisations. While specific workforce and capability implications are therefore difficult to anticipate, it is possible to identify elements that are likely to be common to major digital health changes across the health sector, including:

1. The design of competency standards;
2. Addressing the scope of practice and payment model barriers (where relevant);
3. The development of education curricula for the current workforce (e.g. postgraduate courses, CPD standards, training in the use of workplace-specific digital health technologies); and
4. The development of education curricula for future employees (e.g. undergraduate university curricula, and training in the use of workplace-specific digital health technologies).

Note: There will be a number of significant other non-education related implications of digital health technology introduction (such as requirements for legal or regulatory reform) that are important but not within the scope of the roadmap.

The quantum of change for a given role created by a particular technology will also vary. Some roles will require the development of an entirely new suite of skills in response to the adoption of digital health. Other roles will require a more general uplift of digital capability and literacy.

The journey for each profession will be very different and depend on a range of factors including the maturity of digital innovations, the evidence base for adoption into clinical practice, the take-up by the health profession to trial these new technologies, the number and effectiveness of change champions within the profession, and the level of consumer expectation and demand for services. Ethical and regulatory frameworks may also significantly impact the way these new technologies change health professions, tasks and functions.

Pathology is one health profession in Australia that has already identified new functions, demonstrated outcomes and developed education and training requirements based on digital health disruption.

Case study: genetic pathology curriculum and training - RCPA

The Royal College of Pathologists of Australasia (RCPA) has oversight of the specialist requirements for pathologists in Australasia and sets the professional requirements for each of the nine disciplines within pathology. One of these disciplines is genetic pathology, which is a professional role significantly impacted by recent genomics advancements.

In 2019, the RCPA published new curriculum and training handbooks for each of the nine disciplines. In the discipline of genetic pathology, the handbook describes the discipline-specific functions of the biochemical geneticist, as well as the demonstrated outcomes that must be assessed in order to meet the requirements to be registered as a genetic pathologist. The RCPA has also developed documentation and initiatives to recognise prior learning to accelerate the accreditation process[109].

Case study: use of AI and predictive analytics in cancer care

There are a number of recent examples from Toronto, Canada and Surrey in the UK where digital wearable technologies are being used to assist in the management of people with cancer, including in symptom management, decision making and palliative care management. This technology allows for the monitoring of data over time, including relevant biomarkers and genetic predispositions that are particularly useful in the management of cancer patients who may be subject to treatment-related toxicities[110, 111].

The implementation of these technologies has led to the consideration of consumer adoption and acceptance. "We sometimes think that if we implement remote monitoring technology, somehow patients and practices will do something different and these things will translate into better health outcomes," Dr Doris Howell, Senior Scientist, Princess Margaret Cancer Centre said. "But these things need management. They need facilitation, and they need really good implementation science in order to translate the knowledge we have into better practice."[112]

As a result of the impact on the role of oncologists, curricula have been developed at the Jefferson Centre for Digital Health that allow healthcare providers to understand how to use AI, wearables and predictive analytics. It also provides courses for healthcare providers and administrators who are seeking more advanced capabilities[113]

While in some cases there is clear alignment between digital health and medical specialties, alignment may not be as clearly defined in other health professions. For example, a pain management nurse or allied health professional may undertake training through the Faculty of Pain Medicine (a faculty of the Australian and New Zealand College of Anaesthetists), and this may be greatly impacted by the use of genomics and personalised medicine in the coming years; whereas an intensive care nurse may undertake training through the Australian College of Critical Care Nurses and need to increasingly understand and utilise predictive analytics and the interoperability of different systems to drive clinical decision-making and monitoring of patients in intensive care.

It is therefore expected that while digital literacy will be required across the whole of the health workforce irrespective of the health profession (under Horizon 1), Horizon 2 will require key profession and or speciality stakeholders in different contexts and settings to design professional competency standards, re-evaluate scope of practice, and design education and training curricula and continuing professional development standards to ensure currency in the digital world.

New and emerging occupations

As well as impacting the current health workforce tasks and functions, technology adoption is expected to create demand for entirely new and in many cases highly skilled roles in the sector[114]. For example, the introduction of machine learning tools and other emerging technologies will require a number of new roles, including software engineers; change and project managers; and trainers of the new technologies, noting that these roles already exist to varying degrees. Other anticipated roles include robotics engineers, data scientists and other technical specialists.

Examples of new roles are already emerging in Australia and globally and more are anticipated. Many are focused on the interface between the consumer and the health system. Others are driven by changes to the way care is delivered (underpinned by new digital health technologies and a third group that has emerged in the service of new digital health technologies. This third group includes those who support digital health tools, such as data scientists, data engineers, and engineers supporting robotic systems). Table 6 below provides a summary of some of the new and emerging roles anticipated.

Table 6: New and emerging roles

Consumer interface roles	Care delivery roles	Digital technology roles
• Roles that promote digital adoption by consumers such as **health coaches**. • **Consumer advocacy** roles in health that guide consumers and advocate on their behalf. • **Peer workers** and **volunteers** that increasingly play a role in the provision of care. • Digital **care coordinators** leveraging data to drive more effective treatment and care.	• Executive **insight managers** focused on extracting meaning from health data and driving better operational decisions. • **Health behavioural scientists** taking health insights and crafting compelling interventions that change behaviours. • **Command centre** roles focused on improving patients experience while enhancing efficiency.	• Information technology-related roles that are driven by new technologies and systems (e.g. **health artificial intelligence trainers**, **health data scientists**). • Middle and lower level workforce roles that provide **digital technology support**.

An example of an emerging role is the care coordinator being used increasingly in primary healthcare to assist consumers with their navigation through the health system. This role is illustrative of the cluster of emerging roles focused on the interface between consumers and an increasingly complex healthcare system.

Case study: the emerging role of the care coordinator

An emerging professional role in the health workforce is the care coordinator. While the specific functions of the role tend to be different depending on the care coordination model in place and the priorities of the program they are supporting, care coordinators commonly seek to improve the consumer's mental and/or physical wellbeing, improve the health experience and journey of consumers, and take a more holistic view of a person's health and wider psychosocial needs[115].

This role is becoming increasingly important as many consumers now present with complex chronic conditions, requiring care from a number of healthcare providers. These consumers are frequently receiving fragmented care and may be subject to contravening medications and or management of their multiple health conditions because of a siloing of their healthcare by each individual health professional[116].

The demand for this role is increasing as patients expect that their caregivers are communicating openly, aware of changes to individual plans of care, and have seamless access to their records to provide care that is coordinated and centred on their individual needs. Improving care coordination aims to improve consistency of care through clear communication, integration of healthcare information and collaborative care planning between acute and community-based services[117].

New care delivery roles leverage emerging digital health technologies to provide types of care that were not previously possible or deliver existing forms of care in new or more efficient ways. Examples in the following case studies include healthcare navigators orchestrating care for cohorts of patients and targeted healthcare nudges crafted by health behavioural scientists.

Case study: the emerging role of the healthcare navigator[118]

The role of health navigators in the US is having significant success among patients diagnosed with high blood pressure and/or high cholesterol. The navigators have access to a tailored program that sits over the top of the EHR and tracks information such as patient lab results, vital signs, medication management, titration calls and navigator interactions.

The model of care is unlike other areas of traditional health service delivery, with navigators playing a proactive role in identifying at-risk and at-need patients through proactively analysing results from the EHR. The navigators have two key areas to their role: firstly, the role of mining data to identify patients who would benefit from the navigator program, and secondly, engaging with patients and supporting them with their health concerns.

The navigator program is run remotely, leveraging digital technologies to engage with patients from remote areas, who are otherwise unlikely to access health services. Patients who are diagnosed with high blood pressure often take up to 2 years to improve on a consistent regimen of medication, the health navigator program has been able to see positive results with patients within 8 to 12 weeks.

Two navigator models are currently being trialled: navigator groups of up to 10 who share a pool of patients, and independent navigators managing up to 100 patients each.

Case study: behavioural health communicators[119]

HMS Holdings Corp employs behavioural health communicators who are drawn from a diverse range of backgrounds. Nurses, journalists, and librarians are all counted within their numbers. They have in common a passion for changing health behaviours through communications.

To have a chance of changing behaviours you must 'meet the people where they are'. This means considering the audience for your message. However, meeting the people becomes a daunting task in health systems with millions of consumers.

Leveraging sophisticated digital health technologies and masters-level studies in health communications, the team crafts approximately 1.5 million precisely targeted health messages a day. These are intended to inform, drive behaviour messages, or blend data analysis, cultural insights and communications theory to get cut-through.

They have plenty of data to work with. Every member interaction is tracked, recorded and mined for useful information. They may also use information from medical records. But it is a fine line and, if pushed too far, communications can feel 'creepy'. That is why the team think about building trust and intimacy over time.

They also borrow techniques marketing agencies might employ to segment consumers, rigorously test the effectiveness of messages (think A, B and C testing) and fine-tune delivery down to channel selection and time-of-day preferences.

4.13 Health education priorities

The education and training focus in Horizon 2 is on the changes at a role-, profession- and speciality-specific level across the health system. In addition, there will be a need to develop new curricula, professional standards and training for the new and emerging roles. A summary of these education needs is provided in Figure 10 below. As for Horizon 1, these initiatives and the actions identified by participants in the summit should serve as a starting point for the development of the CAP and the development of specific targets and measures by which to track progress.

Figure 10: Education and training expectations for digital profiles across Horizon

Patient, Consumer and Carer	Frontline Clinical	Digital Champion	Clinical and Technology Bridging
Emerging and New Digital Roles and Ways of Working			
• Growth of consumer advocacy roles in health to reflect the shift towards personalised medicine, care in the home and greater partnership between consumers and health providers in the management of health conditions	• Workforce focus on "Clinical Specialists element" and adopting technologies specific to health service delivery in each speciality, noting the evolution in the way in which health tasks and functions are undertaken.	• Workforce focus on roles that promote digital adoption by consumers and the clinical workforce. This may include digital care coordinators/ health coaches, or digital navigators as the blurring of traditional boundaries occurs due to technology.	• Workforce focus on emerging roles that bridge the clinical and information technology areas (for example the CxIO, Chief Digital Officer, data engineering, but also middle and lower level workforce roles that enable and support these new technologies.
Education and Training for New Emerging Roles			
• Specific tailored programs or courses that may assist consumers (for example similar to the Widening Digital Participation Programme in the United Kingdom).	• Integration of new technologies specific to a health speciality area particularly in specialist medical training, and on-the-job training for those who seek to specialise in a particular area of health (for example a Nurse Practitioner working in urology, or a physiotherapist working in orthopaedics). • For some occupations it will require changes to undergraduate curricula as technology will fundamentally shift the way in which work is undertaken (e.g. radiology, pathology).	• In Specific competencies recognised for Digital Champions and greater recognition for this in career pathways. • Development of undergraduate curricula, or additional qualifications that allow the current workforce to move into digital care coordination, digital health coach or digital navigator type roles.	• Development of undergraduate curricula, or additional qualifications to develop lower and mid level roles that bridge the clinical and information technology divide (i.e. a Clinical Technologist). • In addition Clinical and Technology Bridging roles should be supported by horizontal career pathways from the information technology and clinical areas, as well a vertical career pathway.
Underpinning all Digital Profiles			
Digital governance, ethical frameworks, quality and safety checks and what to do in the case of system failure for each specific technology introduced in a speciality area. It should be noted that some will invite greater ethical considerations than others. It is also expected that such frameworks will start to be developed at an international or World Health Organisation level. Increased consideration and use of micro-credentialing. Introduction of workplace specific education and training that reflect on-the-job requirements and local processes.			

Figure 10 continued: Education and training expectations for digital profiles across Horizon

Technologist	Leadership and Executive	Business, Administration & Clinical Support	Education and Research
Emerging and New Digital Roles and Ways of Working			
• Workforce focus on information technology related occupations that are driven by the new technologies and systems (for example occupations focused on artificial intelligence, computerised algorithms, data science, cyber-legal occupations, and occupations which focus on networking and interoperability of digital clusters and environments.	• Executive roles focused on new business models and processes and systems integration. Traditional service improvement will need to be refreshed and draw on the best balance between human and technology driven health care.	• Workforce focus on human resources and change occupations focused on organisational development, workforce and talent development, and change transformation as a result of the impact of the technologies.	• Workforce focus on working with and supporting emerging roles including clinical and non-clinical front line roles that bridge the clinical and technology domains.
Education and Training for New Emerging Roles			
• Development of undergraduate and postgraduate information technology qualifications that specialise in these new and emerging areas. • Development of micro-credentialing that support the current information technology workforce to keep pace with new technologies and support changing roles, tasks and functions. • Further growth of medical engineering roles and blurring of these in the information technology space.	• Curricula on core digital concepts and opportunities, digital health delivery; and governance and risk management. • Programs and methodologies (e.g. professional certifications) that support the shift of service and process improvement to reflect the changes in business and workforce functions and roles. These would be designed to support the current and emerging executive leaders.	• Programs and methodologies (e.g. professional certifications) that support the current and emerging human resource workforce with large scale role redesign, talent development, and organisational redesign. • Undergraduate curricula and postgraduate curricula changing to reflect the role redesign, talent development, and organisational redesign focus of human resources (noting this will not be specific to health).	• Curricula on core digital concepts and opportunities, digital health delivery. • Programs to support the effective evaluation of new digital health technologies and way of working.
Underpinning all Digital Profiles			
Digital governance, ethical frameworks, quality and safety checks and what to do in the case of system failure for each specific technology introduced in a speciality area. It should be noted that some will invite greater ethical considerations than others. It is also expected that such frameworks will start to be developed at an international or World Health Organisation level. Increased consideration and use of micro-credentialing. Introduction of workplace specific education and training that reflect on-the-job requirements and local processes.			

Horizon 3:
Digital health transformation

4.14 Vision

The focus of the third horizon is on scaled digital health driving transformation across the health system. This will see fundamental changes in where and how health services are delivered.

Personalised medicine, consumer self-care, and value-based medicine will all leverage digital health as they transform the health system. Personalised medicine leveraging digital health is expected to drive changes including greater emphasis on preventative and primary healthcare. Enabled by digital health, consumers will play a greater role in the management of their own health. Value-based healthcare (supported by big data, personalised medicine and predictive analytics) will be important to ensuring that the quality of healthcare does not decline as demands increase.

These changes are already starting to emerge in Australia (and globally). As these forces gather pace, they will drive significant change in the roles and functions of health professions, in addition to models of care, and settings and contexts in which healthcare is delivered. Boundaries between primary, secondary and tertiary care may become blurred through the use of digital health.

4.15 Potential benefits and outcomes

In Horizon 3, healthcare delivery will be transformed through scaled adoption of care outside hospital settings, new healthcare capabilities such as personalised medicine, and new approaches to the management of healthcare resources such as value-based healthcare.

Examples of technologies relevant to Horizon 3

- Personalised medicine – Personalised medicine is a move away from a 'one-size-fits-all' approach to the treatment and care of patients with a particular condition, to one that uses genomics, and environmental and lifestyle factoz to better predict and manage patients' health with targeted, personalised therapies to achieve the best outcomes in the management of a patient's disease or predisposition to disease.
- Smart wearables – Wearable technologies such as wearable electrocardiogram (ECG), electroencephalography (EEG), electromyography (EMG), blood pressure (BP), photoplethysmography (PPG), heart sound, respiration, sleep, and motion monitoring.
- Integration of big data and IoT – Real-time sensing data sets to provide platforms for rich predictive analysis and real-time decision-making[120].

Digital health adoption will drive the following transformations in Australia's health system:

- Organisations better connected to analyse information, and plan and respond to population health demand in a proactive manner;
- Clinicians and consumers leveraging digital health (such as apps) to partner in the management of health, and reduce the cost burden associated with chronic disease;
- Value-based healthcare (enabled by big data and predictive analytics) to drive optimal value for each dollar spent in health;
- Advancements in personalised medicine promoting a proactive and preventative health agenda that reduces health cost per person across the health system;
- Increased healthcare in the home and community helping to improved patient outcomes and experience (and appropriately considers quality and safety risks);
- Real-time data and predictive analytics to improve risk stratification of health conditions, leading to more effective prioritisation of care; and
- New models of care and ways of working that significantly change the way in which health services are delivered and harness the changing and emerging roles from Horizon 2 and the digital health foundations from Horizon 1.

4.16 Workplace changes

Australia's health system will be under increasing fiscal pressures and increasing demand for services driven by a growing and ageing population. These challenges are expected to drive an increased focus on value-based healthcare, personalised medicine and empowered consumers as the health system moves away from traditional health service delivery and approaches to care.

These changes will be experienced internationally. Health systems that proactively plan to adapt will be better able to meet the healthcare demands of the population, and better able to integrate digital health to drive improved quality and safety. They will also be better able to support the workforce through this transition. Key changes that are expected to transform the way in which the workforce is deployed and the skills and capabilities they will require in the future are summarised below.

Value-based healthcare

Over the next decade, value-based healthcare will transform the health outcomes of patients worldwide and support the reduction and management of healthcare costs[121].

Value-based healthcare is grounded in redesigning the healthcare system to deliver value for patients. Value is defined as the outcomes that matter to patients and the costs to achieve those outcomes. Value-based healthcare is becoming one of the most important topics in healthcare as public and private participants seek to drive improvements in quality and slow the growth in healthcare spending.

One of the key challenges in value-based healthcare is gaining agreement on how value should be measured. The concept of Triple Aim, advanced by the Centre for Healthcare Improvement in the US, is gaining support. Value is defined as the "maximum health benefit at minimum cost, and – operationally – better value translates into a combination of improved health outcomes and processes of care (clinical quality), better patient experience, and reduced costs of care"[122]. It is important to note that the definition of value reflects the subjective judgements regarding what matters to whom in the health system.

In outlining a theoretically preferred design for value-based provider payment, five dimensions of value have been suggested by Cattel et al.[123]:

- **High-quality care**: Care is safe, effective, patient-centred and timely. High quality comprises 'technical' or clinical quality as well as patient-reported measures and outcomes;
- **Cost-conscious behaviour**: Scarce resources are efficiently used (i.e. no misuse or overuse);
- **Well-coordinated care**: Multidisciplinary providers communicate and cooperate well in order to realise integrated, well-orchestrated care across the continuum of care;
- **Cost-effective innovation**: Cost-saving services result in equal or better health and health-promoting innovations are worth the additional costs; and
- **Cost-effective prevention**: Deteriorations of health problems are prevented in a cost-effective way.

Technology is expected to accelerate value-based healthcare by providing more reliable data and information about healthcare value and expenditure. This will be enabled by digital health including interoperability, increasing use of clinical information systems across the health sector, and big data. It is expected that value-based healthcare will drive a stronger capability focus on ethics and governance, and patient-centred outcomes across the health system.

Personalised medicine

In the coming years, personalised medicine (also called precision medicine) will provide individually tailored medicine. This will consider the patient's genes, environment and lifestyle. Personalised medicine may focus on disease treatment and/or prevention by building a more tailored and comprehensive picture of the patient's circumstance. This will allow the prescription of medicines, and preventative treatments that will achieve the greatest health benefit for the individual. Examples of this are already being developed. In the treatment of breast cancer, a theranostic (an emergent field of medicine which combines specific targeted therapy based on specific targeted diagnostic tests) identifies the level of the protein HER2, which then determines the most effective drug treatment[124, 125, 126].

It is expected that personalised or precision medicine will drive improvements in health outcomes, medication selection, targeted therapy with reduced adverse effects, and reductions in length of stay. At a system-wide level, it is expected to shift the goal of medicine from reaction to prevention. It is anticipated to enable improvements in cost effectiveness, increase patient confidence, enable novel therapeutic strategies, and alter the perception of medicine in the healthcare system[127].

Consumers as partners in health

In the delivery of care, patients will be empowered to make decisions on their own behalf. For instance, young consumers will be given more power to choose their preferred digital health technology, such as apps for medication prescriptions, apps for storage of medical records, apps for tracking physical symptoms, or apps for tracking medication uptake. Systems and models of care will enable shared decision-making and support a self-care orientation. Information will be available to patients, in a form that they understand, when they want it[128]. Digital health will be available to support the healthcare organisation to meet the needs of patients, to support information and communication exchange in the form and at the time that suits the patient, and to enable patients to participate in decisions about their healthcare in the way that they choose[129].

Care provided will be coordinated and integrated across clinical, ancillary and support services. Transitions between professional disciplines, clinical departments and care settings will be seamless from the patient's perspective. Care will be designed and tailored in partnership with the patient in order to meet their particular needs and preferences[130].

An increasing focus on integrated care and psychosocial factors will be closely linked to patient empowerment and the consumer's healthcare journey. At the heart of this is recognition that each healthcare experience takes into account the whole of the person's healthcare needs[131]. This focus on integrated care provision and wider psychosocial factors will assist in managing the expected increase in comorbidities, chronic disease and complex health conditions, particularly as the population ages[132].

Home and community-based healthcare

Home and community-based models of care that support stable consumers in their homes and reduce the hospital burden of care are likely to increase in prominence. This will include wide-scale adoption of methods that are currently being trialled such as chemotherapy in the home and home haemodialysis. Digital health will also support improved genomics and AI, which will allow for health conditions and disease to be diagnosed at a much earlier stage.

In Australia, as in other countries, it is expected that widespread adoption of the 'medical home' concept is likely. This encourages providers and carers to meet consumer needs in their 'medical home', which for most Australians is their general practice (with 93 per cent of patients returning to the same practice[133]). Delivery of healthcare services either in the patient's home or their medical home will deliver improved outcomes by encouraging better integrated, coordinated, comprehensive and longitudinal care.

4.17 Workforce and capability requirements

Models of care trials

These system-wide changes will require the workforce to interact with consumers and other health professions in new ways, driving a greater focus on integrated service delivery and new models of care. There are already models of care trials around interprofessional service delivery approaches and care in the home. In Australia, these initiatives are being trialled by both the public and private sector. The Medibank Private chemotherapy in the home trial outlined below is an example of a private sector pilot.

Case study: chemotherapy in the home trial – Medibank Private

In May 2016, Medibank commenced a trial program in Western Australia, giving eligible members the choice to receive chemotherapy in their own home. Medibank has since commenced trials in South Australia, Victoria, New South Wales metro and Queensland metro.

Patients benefit by receiving treatment from health professionals in their own home, where they are closer to their family or support network, have increased privacy and reduced time costs associated with travel, waiting and discharge.

Medibank is also trialling home healthcare for palliative care, dialysis and home infusion after receiving strong feedback from patients regarding the benefits of home care programs[134].

Scaled adoption of care in the home will enable new digital tools and ways of working. This may include tools to remotely monitor a patient's condition and care provision. Patients, their carers, and the clinicians involved in their care will need to understand the use and maintenance of these tools. New roles may also emerge that leverage digital capabilities to provide care in new ways.

It is important to note that the significant changes expected in some roles and functions in Australia's health professions and specialities in Horizon 2 will also drive changes to the current way in which models of care, interprofessional practice and the consumer health journey are experienced. Horizon 3 will see the continuation of role redesign across health professions and specialities, and the further adoption of new and emerging roles.

Shifts in capabilities

The health workforce will need to focus on enhancing capabilities to ensure workers are able to keep pace with evolving digital health innovations. In Horizon 3, the key capabilities that will need to be built or strengthened across the health workforce are expected to include:

- Health system transformational change leadership;
- Health system digital health innovation program governance and risk management;
- Consumer oriented care, and whole-of-person approaches including psychosocial factors;
- Primary healthcare with a greater focus on preventative health;
- Personalised medicine approaches and care tailored to a patient's unique context;
- Integration of technologies into the provision of care and digital augmentation; and
- Interprofessional and integrated health teams and models of care.

The adaptation of our health system to leverage these capabilities and transformative digital health solutions will be underpinned by robust ethical frameworks. These frameworks will need to govern how technologies should be applied and address complex dilemmas such as those posed by value-based healthcare decisions.

Case study: MedicineInsight leveraging data to guide clinical practice and quality

Within Australia, the National Prescribing Service (NPS) has established the MedicineInsight program that gathers de-identified health information from medical records from more than 800 GPs and provides this information to clinical researchers for analysis[135]. It provides a national, longitudinal, clinical dataset from which to draw insight and improve practice.

It provides:

- Participating GPs with valuable information about their prescribing patterns and patient care, and provides benchmarking at a local, regional and national level; and
- Quality improvement insights at a national level for health policy makers. Key examples include identification of predictors and outcomes associated with inappropriate prescribing of antibiotics in general practices, and the monitoring and evaluation of the Heart Foundation's Risk Reduction Program[136].

4.18 Health education priorities

Changes in Horizon 3 will be broad based (effecting the entire health workforce) and deep (fundamentally changing the way healthcare is provided). Some digital health education priorities are evident today. Other education priorities will emerge through experimentation. It will take time and challenge scopes of practice and professional roles as they are defined today. The innovative trials of new and expanded scopes of practice and changing models of care will be key opportunities to test and optimise workforce and education interventions. These changes are likely to disrupt traditional approaches to education and training in the health sector.

> *"Digital medicine will require leadership with the capability to direct the agenda, which should include a Board-level member, as well as new senior roles with responsibility for advising boards on digital technologies...[to] enhance the understanding of ethical considerations and strengthen the necessary skills to carry out critical appraisal."*
>
> *NHS, 2019*[137]

It is clear that these are complex changes taking place in a complex system. The leadership capabilities required to transform the Australian health system will be substantial. Traditional leadership competencies that rely on positional authority and expertise will not be adequate. It is widely reported that 70 per cent of major change initiatives fail to achieve anticipated benefits[138]. Sources report even lower success rates for major investments in technology. A new transformation leadership paradigm is required. Opportunities are needed for leaders to develop the required capabilities, including:

- Mastery of key digital concepts to enable the identification of potential transformative healthcare applications.
- 'Hard' digital health investment and governance disciplines including business case development, risks assessment management, and benefits realisation.
- New mindsets and new skills for leading people through complexity and creating more adaptive cultures, addressing deeply held norms of behaviour that will prevent adaptive cultures from emerging. Leaders will need to adopt new mindsets that focus on the higher purpose in healthcare and navigate entrenched mindsets that prevent new behaviours and learning from emerging. They will need new skills to mobilise diverse stakeholders to adopt new ways of working and interacting, skills such as conflict management, collaboration, leading behavioural change, systems thinking and political dynamics.
- Given the scale and depth of change that will be required, leaders will also be faced with an increasingly important role of ensuring their own resilience, self-management and wellbeing as well as ensuring these factors are receiving attention across the workforce. The complexity, uncertainty and volatility that will continue at unprecedented levels over sustained timeframes will take its toll on the health and wellbeing of the workforce, as increasing demand coupled with rapid change, impacts on every individual and potentially on the quality of care and health outcomes.

Enablers and opportunities

5 Enablers and opportunities

Advancements in technology create the potential to address some of the most persistent challenges to the delivery of accessible and sustainable health outcomes. However, Australia's health system is diverse and complex. There are many organisations responsible for the health of consumers, and the responsibilities for funding, policy, regulation and service provision vary across jurisdictions.

Collaboration will be critical to the successful implementation of the roadmap. No single organisation can achieve the desired workforce and education outcomes alone. Collaboration between governments and other health sector participants poses a key challenge for delivering the workforce necessary to realise the National Digital Health Strategy objectives. A national approach must draw on and facilitate good practices and replicate, not duplicate, existing activity.

Throughout the consultation process for the roadmap, several 'enablers' have emerged that will help to catalyse the workforce and education changes to support digital health benefits. Acting on these enablers will also serve to address barriers of digital health innovation and adoption. This section outlines these opportunities. Collective efforts to address these will set the path for the next wave of activity towards a digitally capable Australian health workforce.

5.1 Targets and measures for collective action

Many components need to come together to achieve the potential of digital technologies in the health sector. These include the foresight to identify opportunities and drive investments in digital health solutions; successfully navigating the complex pathway to implementation; development of workforce capability and the willingness to adopt digital health solutions; and interoperability to share information across settings and time. Isolated investment in any one of these components will undermine the ability of the system to achieve the intended benefits.

Further, achievement of each of these components requires the coordinated efforts of a range of health system participants including governments, educators, standard setters and peak bodies. To drive beneficial adoption of digital health solutions the specific activities required of individual participants will need to be agreed and performance targets defined, acknowledging that differences between the digital capabilities of each state and territory must be factored into any contemplation of performance targets. National leadership will be required to create context for collaboration and an expectation of progress. This process will highlight potential dependencies between participant actions and opportunities for collaboration and partnership. Measurement of the achievement of targets will also support governance and benefits-tracking mechanisms and ultimately benefits realisation.

Appendix D contains a draft framework for understanding complementary actions of different health system participants to develop the digital capabilities of the workforce in pharmacy. It identifies at a high level the activities of health sector participants that are necessary to support progression to higher levels of maturity. This framework can be used to gain agreement on actions required to support beneficial adoption of digital health solutions in other segments of the health system.

5.2 Board and executive mobilisation

Leadership will be critical because the changes required to deliver a workforce confidently using digital health technologies are complex – more so because these changes take place in an already complex system. The changes associated with emerging technologies are also not discrete. Changes to roles and functions will continue to emerge as technologies grow and develop.

A baseline understanding of the transformative potential of digital technologies in health is required at senior levels. Without this understanding, digital health capability development will not be prioritised. Boards and executives need foundational knowledge covering key digital concepts. They also need case studies demonstrating how these concepts can be applied in recognisable contexts to drive benefits. Empowered with this knowledge, more leaders will be willing to invest the time and effort required to drive digital health capability initiatives.

Opportunity: Board and executive primer

Development of common digital health education resources including core concept 'primers' and case studies focused on benefits of digital tools (in healthcare and other recognisable contexts). These resources could be used to enhance the understanding of boards and executives across the sector including in government, hospital systems, universities, regulators and peak bodies.

Driving successful change will require empowered leaders with the ability to influence change, collaborate, and focus on continuous improvement[139]. Networks of change champions will need to work together across enterprises and the wider system to engage workforce groups in transformative efforts. The skills required to lead in these complex environments are different to the skills leaders may have relied upon in their careers to date. In addition to specific digital health education and training, development opportunities that build and activate adaptive and transformative leadership capabilities for boards, executives and change champions will also be needed.

Leaders charged with the delivery of digital health innovation will face two distinct sets of considerations:

- **Technical complexity:** How to understand opportunities and evaluate risks with unfamiliar technologies and novel applications; and
- **Organisational complexity:** How to effectively integrate technology and the workforce and manage the human impacts, including changes to current roles and the creation of new roles, and maintaining employee engagement[140].

People are the key to a successful organisation, and in health this is particularly true. If leaders are proactive in planning the way the future of work plays out, they will have a greater chance of creating systems characterised by a positive culture, embedding of technological transformations, and a committed, contemporary workforce.

Opportunity:
Transformational leadership tools and capabilities

There is an opportunity to develop transformational leadership resources and development opportunities for leaders charged with delivering transformation in the health sector. These resources and development initiatives should help equip leaders with the mindsets, skills, personal capacity and the digital dexterity[138] required to drive digital health transformation. Resources could include formal but practical leadership training and a broader set of tools that leaders can draw upon as they build the case for change and drive reform (e.g. practical materials and case studies to help establish business cases, tools and frameworks for anticipating and addressing workforce impacts, and benefits realisation tools).

5.3 Cultivating lifelong learning

Learning and continuous improvement is increasingly important with the rapid evolution of digital technologies. Technological advancement necessitates urgency when it comes to cultural change across the health sector. The opportunity and challenge to embed curiosity and continuous learning as cultural norms within the system cannot be underestimated. For individuals and culturally, capability, curiosity and self-directed learning should be fostered throughout the entire health workforce. This will require cultural leadership.

Increased demand for higher skilled workers in the economy means that existing education and training systems need to change at undergraduate and postgraduate levels[142]. Learning in the workplace is also important. However, an onus on individuals to take ownership of their own development throughout their careers should be a cornerstone principle

> *"With accelerating advances in health information and technology, physicians, nurses, and other health professionals must maintain and improve their knowledge and skills throughout their careers. That's the only way to provide safe, effective, and high-quality healthcare for their patients."*
>
> *HealthManagement, 2019[143]*

New career pathways will need to be identified (Clinical and Technology Bridging roles for example) to help individuals imagine and realise their future. There is a need for education and training to be more responsive to the needs of individuals within the workforce, enabling them to take ownership of their own development. Importantly, digital literacy and capability education will need to connect the use of digital health with the higher purpose of providing healthcare. This will be challenging and require support from a variety of different stakeholders across the system[144].

Opportunity:
Self-directed learning experiences

Health practitioners are well positioned to identify areas where learning activities could improve their ability to provide patient care in a digital health environment. It will be important to enable clinicians to engage as active participants in their own learning path. Collaboration between employers, professional bodies and education and training providers can provide opportunities and incentives for self-directed learning to complement face-to-face, formal and relationship-based learning.

5.4 Shared education resources

Core capabilities such as those associated with baseline digital literacy will be common across the sector. Even when considering digital health technology change specific to a profession, specialism or role (for example the introduction of a new system) there will be capability requirements that are the same as those associated with changes in other areas of the sector. Having a common approach to the definition of digital capabilities may enable those undertaking digital health technology initiatives to avoid duplication of effort. Consistency may also unlock other system benefits including enhancing the fungibility of human capital.

Providers of education emphasise the need for resources to support the delivery of curriculum change. Education content such as video, exercises and activities that can be incorporated into curricula decreases the cost of developing new courses. It can also enrich the learning delivery. Resources to allow the practical application of digital health capabilities in education are also valuable. For example, access to training sandpit versions of public health systems (e.g. EMR in NSW or in Queensland) would enable students to gain firsthand experience on the systems they will use later in the workplace, although it is acknowledged that privacy and data security obligations within states and territories limit this ability.

Opportunity:
Digital health resource clearinghouse

A clearinghouse should be established to provide access resources for those developing standards and education programs. Access should be provided to universities, VET and other education providers, boards and accreditation bodies, and employers. Access to shared resources will aid consistency and avoid duplication. The clearinghouse should identify common needs, commission production of relevant resources (encouraging co-development where beneficial), negotiate access of relevant resources such as technology systems, and management of access to resources. This should include tracking the return on investment of resources.

Shared education and resources should include the Transformational Leadership Tools and Capabilities discussed in Section 5.2.

5.5 Ethical frameworks

Ethical principles are utilised across all aspects of healthcare delivery and embedded within professional codes of ethics to avoid causing harm. There are four widely used ethical principles in healthcare:

- **Autonomy** encompasses self-determination or the ability to access information pertinent to decision-making, independence or following one's own values, freedom to choose a course of action free of coercion, and agency or the power to be in control of and responsible for one's actions.
- **Beneficence** obligates the healthcare professional to provide assistance to others and to promote the patient's unique view of health and individual perception of good health.
- **Non-maleficence** is the principle that one should do no harm. Included is avoidance of risk of harm where it is known that certain interventions carry risks or harms, but beneficial outcomes may outweigh the harms.
- **Justice** is central to the core concepts of ethical behaviour, rests upon mutual recognition of human dignity, and requires that all people be treated fairly and equally.

Digital technology such as AI creates a set of ethical challenges that must be identified and mitigated due to risks around patient privacy and confidentiality, boundaries between the role of machine and physician, and lack of physician education around technology in medicine[145]. However, current policy and ethical guidelines for digital technology are lagging behind the progress that digital technologies have made in the health care field. Ethical frameworks for digital health are an emerging area. For example, the UK's Association of Medical Research Charities (AMRC) has developed a set of nine core ethical principles, which build upon the four listed above and are relevant to the development of digital health: beneficence, non-maleficence, autonomy, justice, explicability, sustainability (financial and operational), open research, community mindedness and proportionality[146].

Case study: artificial intelligence, Australia's Ethics Framework

AI has the potential to impact multiple sectors; however, users need to trust the AI applications developed by business, governments and academia.

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) developed a discussion paper, funded by the Department of Industry Innovation and Science, outlining Australia's Ethics Framework for AI. It provides guidance on how to approach the ethical issues that emerge from the use of AI[147]. The ethics framework proposes eight core principles for AI – generates net benefits, do no harm, regulatory and legal compliance, privacy protection, fairness, transparency and explainability, contestability, and accountability. In addition to these principles, the paper outlines a set of tools that can be used to assess risk and ensure compliance and oversight; impact assessments, internal or external review, risk assessments, best-practice guidelines, industry standards, collaboration, mechanisms for monitoring and improvement, resource mechanisms and consultation.

The Royal Australian and New Zealand College of Radiologists (RANZCR) responded to CSIRO's discussion paper through developing a set of clinical radiology and radiation oncology ethical principles for AI. RANZCR suggested that the priority given to each of the CSIRO principles should be reviewed[148]. The response paper outlines the most appropriate use of AI and machine learning within the radiology field, including how both can successfully help drive better patient care[149]. The framework outlines eight principles with a different priority order to that of CSIRO: safety, avoidance of bias, transparency and explainability, privacy and protection of data, decision-making on diagnosis and treatment, liability for decisions made, and application of human values and governance.

Opportunity:
Harmonise ethical foundations and guidelines

A consistent view of the ethical principles underpinning safe and appropriate use of digital health will aid all health sector participants. However, a one-size-fits-all approach is not likely to address all situations and contexts. Work to understand and prioritise how ethical foundations are applied in practice should focus on areas where the risks to patients and consumers are greatest. Targeted development of more granular ethical guidelines in these areas should promote adoption and prevent harm.

5.6 Partnership and collaboration

Collaboration and partnerships across the health sector and with education providers will be required to overcome barriers to adoption and ensure a holistic approach to digital health. The roadmap will not be the responsibility of any single entity to deliver. Instead, it will require stakeholders across all parts of the health and education system to work in collaboration and partnership.

Different levels of maturity exist across health professions and roles, across different settings and contexts, and across hundreds of different employers and tens of thousands of employees. Digital health advances will therefore proceed at different rates across the sector. Areas of relative maturity should be regarded as an opportunity for experimentation and learning and can be synthesised and shared to inform less mature players. Solutions to challenges in one area of the sector may be achieved through collaboration with other areas where similar challenges have already been overcome.

To advance workforce digital health capabilities, governments and the private sector will need to find new ways of working together on areas of shared responsibility. This will require collaboration, national coordination and local leadership. As a priority, health sector participants should agree initiatives to boost baseline digital literacy across the health workforce. Much has been written about the challenges of collaboration across government and non-government bodies and building a culture and will for collaborative effort is a major area of opportunity. It will require shared aims, trust, development and collaborative leadership.

Opportunity: National Digital Health Capability Action Plan (CAP)

Participants across the health sector should build on the foundations agreed in the Framework for Action and the horizons identified in the roadmap to agree on priorities and accountabilities for driving tangible activities to deliver digital health capability uplift in the CAP. Agreements should emphasise collaboration and sharing of better practices. Further, agreement should also include appropriate targets (discussed earlier), governance and benefits-tracking mechanisms, aligned to those of the Framework for Action.

5.7 Building on My Health Record

The expansion of My Health Record included a range of activities aimed at improving understanding of the record and its use. These included initiatives to reach consumers (such as work involving the Good Things Foundation, Australian Library Association, and Diversewerks) and a range of clinical stakeholders through work with peak bodies. The approaches pioneered through this work should be leveraged and refined to encompass a broader range of digital health awareness and capabilities.

Opportunity: Extend existing capability development initiatives

There is an opportunity to leverage existing models of capability development. Work with organisations including clinical peaks to develop training and development resources for My Health Record can serve as a template for broader digital health capability development. Development work done by clinical peaks should draw upon the shared education resources described above to minimise duplication and maximise consistency.

5.8 Delivering workforce and education objectives

Focus on these opportunities will aid the realisation of the workforce and education changes necessary to deliver digital health vbenefits. Additionally, delivering these opportunities will support the achievement of the workforce and education objectives identified in the Framework for Action (shown as the row titles in the table below).

Table 7: 2022 objectives identified in the strategy and Framework for Action

Strategy and framework objectives (selected key components)	Board and executive primer	Transformational leadership tools and development	Opportunities for self-directed learning	Education resource clearinghouse	Harmonise ethical foundations and guidelines	National Digital Health Capability Action Plan	Extend existing capability development initiatives
Access to resources	✓	✓	✓	✓		✓	✓
Confident and efficient use of digital services		✓	✓		✓		
Education curricula	✓		✓	✓	✓		✓
Training materials	✓	✓		✓			✓
National standards and accreditation requirements			✓	✓			
Clinical resources				✓	✓		✓
Evidence for how, when, and where digital health should be used	✓	✓		✓	✓	✓	
Network of chief clinical information champions	✓	✓	✓			✓	
Cultural change	✓	✓	✓			✓	

5.9 Next steps

A draft of this roadmap was a key input into the National Digital Health Workforce and Education Summit held on 20 November 2019. The summit brought together key stakeholders across health, with the goal of developing a shared understanding of the work required to support achievement of the goals described in Australia's National Digital Health Strategy. The summit sought to agree specific tangible commitments from health sector participants and develop measures against which progress can be tracked.

In advance of the summit additional reference materials were released to attendees. This included reference points to support participant action planning in the summit. The Agency is exploring the development of a digital adoption maturity scale, mapping typical progression towards beneficial adoption of digital health solutions. The scale will be elaborated in the CAP in concert with jurisdictions. Such a scale could be used in a number of useful ways:

- A maturity scale provides a basis for understanding the current state of digital health in a given segment of the health sector, agreeing priorities and setting targets; and
- Example participant actions aligned to each maturity level can help to fast-track summit planning processes to identify specific actions and measures.

Through the summit consultation process the foundations of a CAP were established. The CAP, along with the finalised roadmap, will provide guidance to participants across the sector on the work required to support beneficial adoption of digital health solutions. They will also provide a basis against which to measure progress and identify areas where additional focus may be required. As highlighted previously the development of the CAP will occur following finalisation of the roadmap and is a critical next step to ensure implementation of the roadmap and realisation of the benefits that will flow to Australia's health workforce.

Work is underway in many areas; however, a coordinated approach is needed. This will require leadership, support and engagement from participants across the health and education sectors. It is critical that the pathways and roles to build the digitally capable health workforce are clearly articulated, widely understood, adopted and enacted.

The change ahead is exciting, and the development of the roadmap recognises the importance of a digitally capable health workforce as central to delivering health services and outcomes, now and into the future.

Appendices

Appendix A: Global Insights

Initial global scan

A global scan of academic and grey literature was undertaken in July/August 2019 to understand best-practice approaches to preparing the healthcare workforce for the digital future. For the purpose of this project, and to inform this roadmap, the research has been focused on initiatives and strategies being deployed to better describe the changes ahead (including any digital competency frameworks), programs and strategies aimed to train and upskill the workforce to enable digital literacy, and any other key considerations across the international literature, including challenges, opportunities and lessons learned.

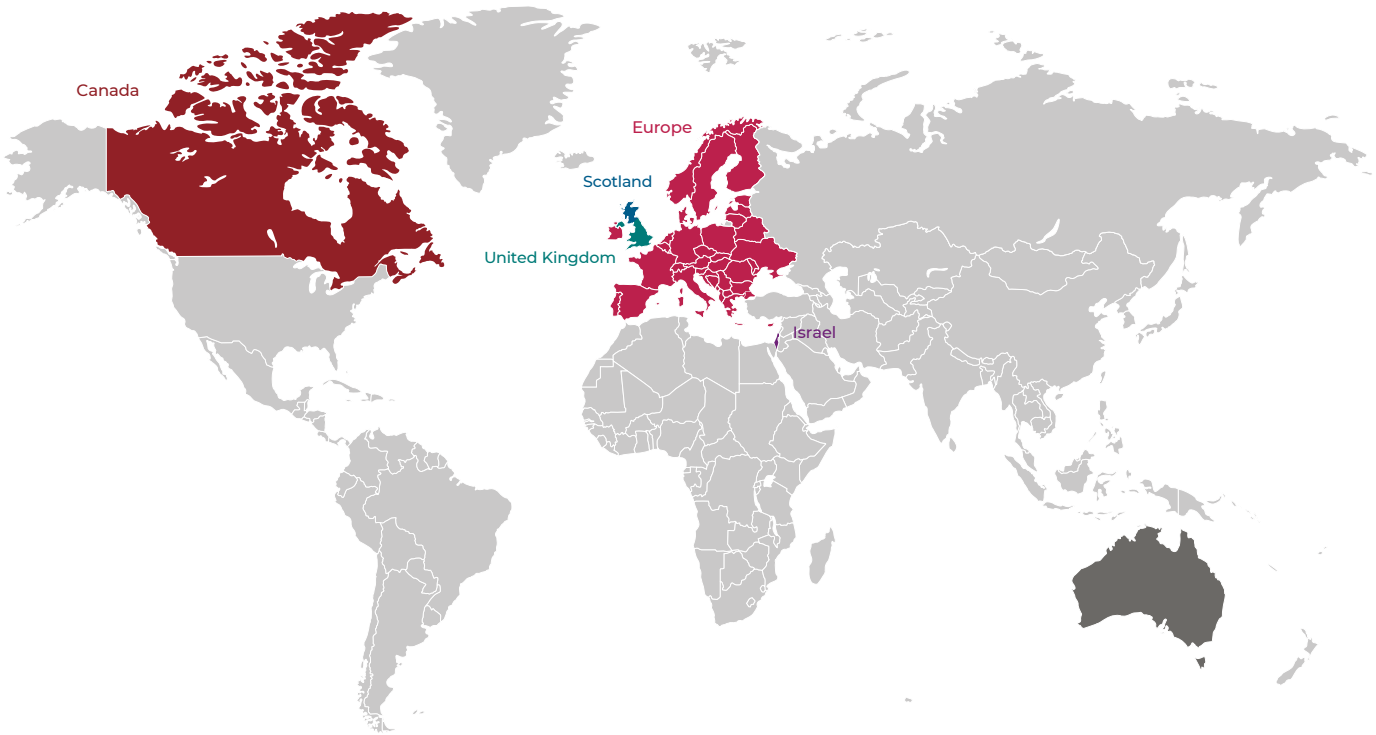
Key search terms used in the analysis included (but were not limited to) "digital health workforce", "worker of the future + health" "digital health capabilities" "health workforce + digital", "health workforce + technology/ies". In addition, some key papers (such as the Topol Review) were already identified as being key to the analysis. The findings from these searches were then used to identify further sources. Given the prevalence of non-academic articles, relevant government websites were also searched for key words (such as the NHS) to identify key literature. Global networks utilised by the Agency were also consulted to ensure that all key documents and literature were included. There was also a specific focus on literature developed by the World Health Organization.

The global scan scope for the desktop review initially started with the United States, Canada, New Zealand, Scotland, the United Kingdom, Norway, Finland, and Israel, but due to the limited amount of information relative to the training and capability uplift of the health workforce, has been limited to Europe, the United Kingdom, Scotland, Canada and Israel.

High-level overview of initiatives by country

Over the last few years there has been significant interest in, and emergence of, literature and thinking around the future of work and the impact that digital technologies will have on the health workforce. However, there has not been as much focus on the planning, programs and strategies that are needed to improve the digital health literacy of the health workforce, including understanding how this may look different across different health professional roles, settings and contexts.

The analysis below shows a snapshot of the key initiatives identified across the five geographies included in the analysis.



United Kingdom (incl. Scotland)

Health Workforce: Approx. 1.25 million in the health workforce in 2018[150]/ Population of approx. 66 million

Initiatives/ Key Literature

- Widening Digital Participation Programme, 2013
- NHS A Health and Care Digital Capabilities Framework, 2018
- Building a Digital Ready Workforce
- Technology Enhanced Learning Programme
- Genomics Education Programme
- Facing the Facts, Shaping the Future, 2017
- Topol Review, 2019
- NHS Long Term Plan, 2019
- Future of Surgery Report, 2019
- Improving Digital Literacy

Scotland

Health Workforce: Approx. 160,000 in the health workforce in 2019[151]/ Population of approx. 5.3 million

Initiatives/ Key Literature

- Digital Health and Care Institute
- Digital Health and Social Care Strategy
- Digital Participation Charter
- Digital Champions Development Programme

Canada

Health Workforce: Approx. 750,000 in the health workforce in 2017[152]/ Population of approx. 36.7 million

Initiatives/ Key Literature

- Canada Health Infoway
- Adopting eHealth Solutions: Implementation Strategies, Best Practice Guidelines
- Digital Health Canada 2017-2020 Strategic Plan
- Study of Digital Health in Canadian Schools of Nursing: Curricular Content and Nurse Educator Capacity
- The White Paper on the Impact of AI on Radiology

Israel

Health Workforce: Approx. Approx. 100,000 in the health workforce in 2018[153]/ Population of approx. 8.7 million

Initiatives/ Key Literature

- National Digital Program of the Government of Israel
- Digital Health Strategy
- Israel Innovation Authority
- Digital Health Innovation Partnership with Finland

Europe

Health Workforce: Approx. 23 million in the health workforce in 2011 / Population of approx.741 million

Initiatives/ Key Literature

- Digital Health Roadmap EU
- Joint Action on Health Workforce Planning and Forecasting
- Digital Health Europe
- IC-Health initiative

Country profile: United Kingdom

The focus on digital technologies in health in the United Kingdom has increased over the last few years, including a focus on the impact of digital technologies on the health workforce. This is occurring at the same time as health workforce shortages are being reported across the NHS trusts which are expected to worsen, driving a need to focus on workforce planning and sustainability, as well as driving a need for new ways of working in the health sector. As in most health contexts around the world, the NHS operates in a fiscally constrained environment which impacts not only workforce recruitment but has also led to a reduction in funding available for education and training of the health workforce[154].

NHS Digital

NHS Digital was established in 2013 as the national information and technology partner for the health and social care system across the United Kingdom. The key mission of NHS Digital is *"to harness the power of information and technology to improve health and care"*. They are playing a key role in the delivery domains set out in the *Personalised Health and Care 2020* strategy published by the National Information Board[155]. This strategy, published in 2014, brings together the ambitions of the *Government Digital Strategy* (2013), Department of Health's *Digital Strategy: Leading the Culture Change in Health and Care* (2012); and proposals in the Department of Health's *Power of Information* (2012)[156].

In 2017, NHS Digital released a report titled "Fit for 2020: Report from the NHS Digital Capability Review". This paper was a review of the capabilities within the NHS Digital itself and found, among other things, that there were ambiguous expectations and blurred operational boundaries across the health and care system. It also found its focus was on out-of-date technology areas, and the adoption of innovative digital solutions and automation is often too slow[157].

This has led to a number of reforms to programs across NHS Digital. Of most relevance to the roadmap are programs which focus on empowering the person, support consumers in making informed decisions about their own healthcare and supports consumers with making choices about health services based on digital technologies. One of these programs is the Widening Digital Participation Programme.

Widening Digital Participation Programme, 2013

This program was established in 2013, and its first three years were delivered in partnership with the Good Things Foundation drawing on their network of UK Online centres in lower socioeconomic areas. It was focused on addressing the digital health literacy of "digitally excluded people" with a focus on homeless people, older people in rural areas, patients in secure mental health hospitals, and those whose first language was not English[158].

The initial focus on the program was to identify the greatest needs and better understand the challenges faced by these consumer cohorts. The program is now focused on developing and piloting user-centred approaches to addressing digital exclusion, addressing the digital divide at a system-wide level by working with the commissioners and designers of digital health services, and developing a set of digital learning products to raise awareness about digital technologies[159].

Health Education England (HEE)

Established in 2012 as a Special Health Authority, the HEE evolved to a non-departmental public body (NDPB) by 2015. HEE sits under the provision of legislation in the UK – the Care Act 2014. HEE's remit is to provide the health workforce with the right skills to support 'excellent healthcare to patients and the public of England'. The focus of their work is primarily on upskilling the digital literacy of the current healthcare workforce. HEE's mission is *'to help everyone in the health and care sector in England gain confidence and proficiency with using digital tools in their roles to improve the level of service quality'*[160].

A driving principle is to build a culture in the healthcare workforce that recognises the need for innovation and the role of digital technology, and particularly how it can transform healthcare delivery. Importantly, this program incorporates non-clinical and clinical staff alike, recognising that the frontline healthcare workforce has a significant part to play in service delivery.

HEE define digital literacy as *'those capabilities that fit someone for living, learning, working, participating and thriving in a digital society'*, and the digital literacy project seeks to improve the digital capabilities of everyone working in the healthcare sector. HEE has a range of programs to deliver on their remit of supporting the health workforce, such as the HEE Technology Enabled Learning (TEL) Programme, the Digital Literacy Project and the HEE eLearning for Healthcare (e-LfH) Programme[161]. At a high level they define the digital literacy capabilities as "capabilities that fit someone for living, learning, working, participating and thriving in a digital society", and have broadly defined it as having six key domains:[162]

- Information, data and content;
- Teaching, learning and self-development;
- Communication, collaboration and participation;
- Digital identity, wellbeing, safety and security;
- Technical proficiency; and
- Creation, innovation and research.

These are further described in the Digital Capabilities Framework.

Digital Capabilities Framework, 2018

HEE developed this framework in 2018 following extensive stakeholder consultation with the intention of providing an outline of the digital capabilities to support digital literacy for the health workforce. Across the six key domains, distinct capabilities are described at four different levels ranging from basic to expert. It is designed to be applicable to anyone working in healthcare as a developmental and supportive tool. The framework is designed as a dynamic and iterative document that outlines the generic capabilities that support individual professional development[163].

Building a digital ready workforce

This national program of work led by Health Education England (HEE) is part of the Personalised Health and Care 2020 portfolio. The aim of the program is to build a digital ready workforce using products and services already in existence. A driving principle is to build a culture in the healthcare workforce that recognises the need for innovation and the role of digital technology, and particularly how it can transform healthcare delivery. Importantly, this program incorporates non-clinical and clinical staff alike, recognising that the frontline healthcare workforce has a significant part to play in service delivery[164].

In essence the program is intended to be delivered through four key work streams:[165]

- *Leadership and culture*, understanding that leadership sets the operating and behavioural culture in their organisations. The aim of this work stream is to position leaders to set the right culture and empower their staff to be part of the solution in developing digital literacy through improved capability.
- *Professionalism*, the UK has between 25,000 to 50,000 informaticians in the NHS, such as data analysts, librarians and futurologists- all of whom have a key part in helping the health and care industry to evolve, adapt and change.
- *Digital Academy*, the NHS Digital Academy is the first ever 'nationally' funded health informatics training academy. The academy provides specialist IT training and development (and support) to 300 senior clinicians and health managers over a 12-month period. The key focus is to shape a 'new generation' of chief information officers and chief clinical information officers to drive digital transformation.
- *Digital literacy*, working in partnership and collaboration with professional groups (nurses for example) the program seeks to identify barriers to the adoption of digital health and to define support they would need to become digitally literate. This will further inform work to remove identified barriers.

Technology Enhanced Learning Programme

The HEE have established technology enhanced learning to explore how digital technologies are changing the way in which the health care workforce receives education, training and capability development. Key examples of this include their exploration of a simulation-based education framework, HEE's Learning Hub and HEE eLearning for healthcare. A key goal of the simulation strategy is to ensure that blended learning using simulation, eLearning and other technology and techniques become integrated in curricula, training pathways, and continuing professional development for the health workforce[166].

Genomics Education Programme

This program, developed by HEE, seeks to upskill the health workforce to enable it to embrace genomic technologies. This includes a toolkit of resources including factsheets, online learning modules and a MOOC. It is expected that this will be expanded to help support the workforce with gene therapy and editing and personalised medicine[167].

Facing the Facts, Shaping the Future, 2017

In 2017, the NHS released the Facing the Facts, Shaping the Future which is a draft health and care workforce strategy for England to 2027. This strategy seeks to look to the ten-year horizon and notes that:[168]

> *"Health and healthcare will continue to benefit from research, technology and innovation with for example precision medicine seeing rapid progress. Broader developments such as portable digital diagnostic devices may further change how patients, users and staff manage healthcare in the future. The implications of these for the 2027 NHS workforce may be hard to assess, but ready access to information, genomic medicine and advanced robotic surgery will undoubtedly affect the shape, size and skills of the health workforce."*

This report notes the Secretary of State for Health's commissioning of the Topol Review to determine how technological developments are likely to change roles and functions of clinical staff, identifying subspecialty areas where this is expected to be particularly significant, and the consequences of this for education, curricula, professional development and lifelong learning[169].

Topol Review, 2019

The Topol Review was led by cardiologist, geneticist and digital medicine researcher Dr Eric Topol and is seen as the leading report in the UK that will enable NHS staff to make the most of innovative technologies specifically, genomics, digital medicine, artificial intelligence and robotics to improve services.

A key feature of the Topol Review 2019 is the evolving health workforce and how this will affect the current workforce roles changing the way leaders work across the health sector to drive integration of new technologies. The flow-on effects of this are to also prepare all clinicians from cross-disciplinary areas to be capable and effective within the digital space. This, in turn, will impact education providers and colleges to develop curricula which will need to continue to adapt to prepare graduates entering the health workforce[170].

The Topol Review highlights that workforce capability begins with organisational design suggesting the following areas for consideration:[171]

- *An open and inclusive innovation culture*, as this has a major impact on the speed and frequency of innovation. Non-hierarchical, self-organising and multidisciplinary teams and effective knowledge management.
- *Prioritising people*, participatory design principles considering 'what matters to people' as research has shown that sustaining use of technological solutions is dependent on a cross-section of stakeholders including patients, consumers and healthcare staff using what they have been involved in building. Another important factor according to the review is 'making time for staff to learn'.
- *An agile workforce*, coping with disruption as healthcare roles will become more fluid due to rapid technological advances and changing needs of consumers. A multigenerational workforce has changed expectations of work-life balance and flexible careers, rewards and incentives. As well, emotional and social skillsets will become more important.

- *Establishing effective governance arrangements for digital health*, poses a challenge for regulators and policy makers due to the rapid pace of technological change. Protecting patients and society to reduce the risk of harm requires trust from both clinicians and patients.
- *Providing a learning environment for education and learning*, made possible through an effective culture of learning at every level. Addressing recognised barriers such as resistance to change and scepticism relating to technology is possible through a motivated workforce that is confident in its adaptation of technology. While lifelong learning is already accepted in the healthcare industry, translating this to digital lifelong learning is the challenge.

Key recommendations relevant to the roadmap include:

- Creating a learning culture through encouraging lifelong learning, openness to collaboration, effective co-design and understanding human intelligence;
- Supporting educators;
- Education and development of the whole workforce through specialist workforce and specialist teams, support for existing and new roles addressing skills gaps, flexible and responsive training for specialist roles and working collaboratively with accreditation organisations; and
- Educating the future workforce with education providers ensuring genomics, data analytics and AI are included in undergraduate curricula, education providers ensuring students gain an appropriate level of digital literacy and education providers offering digital learning opportunities in the health faculties outside of other fields of study such as engineering and computer science.

NHS Long Term Plan, 2019

The NHS Long Term Plan, released in 2019, makes a number of recommendations about the adoption of digital technologies as well as transformation that will need to take place to empower the health workforce to drive the digital future. Recommendations made include:[172]

- The information technology revolution in the NHS needs to support the workforce and not become a burden for staff;
- Supporting staff working in the community setting to have greater access to mobile technologies and services to assist them in performing their role;
- Further investment in enhancing the digital leadership of the NHS;
- Patients, clinicians and carers will have technologies that are designed to help them;
- All providers across community, acute and mental health will be expected to have a core level of digital literacy by 2024; and
- Technology will enable the NHS to redesign clinical pathways and assist them to improve the quality and safety of care.

At the Reform Healthcare Conference in 2019, the NHS Chief Executive, Simon Stevens flagged a commitment to drive artificial intelligence in health across the NHS, which will have significant health workforce implications (also flagged in the NHS Long Term Plan, 2019). He said:[173]

> *"We are seeing an artificial intelligence revolution that will be a big part of our future over the next five years... so from April next year we propose to change the way in which we fund care so that NHS organisations who invest in this world-leading technology will be properly rewarded for doing so."*

Health workforce digital capabilities being driven by professions/ medical specialties

In addition to the above initiatives and programs of work in the United Kingdom which are focused on improving digital literacy through systems, frameworks, training, capability descriptions, there is an increasing focus on the way in which digital technologies will impact on health clinical roles at a profession or speciality level. The following outlines some of these initiatives (based on information that is publicly available):

Future of Surgery Report, 2019

This details the expected key technologies that will impact medical surgeons (including all subspecialties) over the coming years. Key findings relevant to the roadmap include:

- Key technologies expected to drive the greatest change for surgeons include minimally invasive surgery, virtual reality and augmented reality, big data, genomics, specialised interventions;
- Surgery and healthcare will change for patients in the future by shifting towards health prevention and promotion, there will also be less invasive surgery with more rapid recovery, and advancements in medications and pharmaceuticals which may make surgery obsolete for some conditions;
- The availability of more health information and data may assist consumers regarding the management of their own health but may also drive increased anxiety. Consumers may need specialist advice and support to make decisions about their care, and access to data and medical knowledge may drive further inequalities in healthcare between the most disadvantaged consumers and other consumer groups;
- Recognition that the content of surgical training and curricula will need to change to reflect the likely future career of the surgeon, with a greater focus on entrepreneurialism and innovation as well as clinical elements of the role. Training will need to include knowledge of computing, engineering, molecular biology, data literacy, leadership, team building, communications and continue to ensure and enhance the "humanity" in surgery.

Royal College of Nursing Digital Summits (in 2015 and 2016)

These summits led to the commitment that by 2020, every nurse would be an "e-Nurse". It also led to a collaboration between the Royal College of Nursing and HEE titled *Improving Digital Literacy* which outlines some of the key barriers and opportunities that exist to help embed digital health across the nursing workforce. This document also includes a digital manifesto by the Royal College of Nursing which, in relation to digital health capabilities, includes a commitment to:[174]

> *"Promote and develop capabilities that describe new and emerging challenges rather than competencies focusing only on current skills in known roles;*
>
> *Support the HEE digital literacy definition and framework which applies to all registered nurses and midwives with capabilities that can be mapped to the NMC code; and*
>
> *Develop digital capabilities throughout nursing to open up the potential for a true partnership that encourages individuals to be fully engaged in their health and healthcare management."*

Country profile: Scotland

Scotland is considered to have a mature and stable healthcare system with extensive academic expertise. The Scottish Government are committed to becoming a world leader in digital healthcare, demonstrated by their funding of initiatives aimed at innovation in digital healthcare. This has enabled Scotland to cultivate innovation in digital healthcare with a significant focus on developing the workforce, infrastructure and policies, with the key driver being to improve the lives of the Scottish population in both urban and rural communities.

The majority of Scottish citizens believe the IoT and smart technologies have an ability to enhance healthcare delivery; however, the country has been found to have some underlying challenges that could inhibit their adoption and uptake. The Scottish Productivity Index, launched by CBI Scotland and KPMG, found that Scotland is lagging behind other parts of the UK or international competitors in nine out of 15 key indicators. One of the recommendations for government and business was to set a target for 100% of the workforce to have basic digital skills by 2025 – with government and business working together to ensure everyone can benefit from the digital economy[175].

The Scottish Productivity Index

The inaugural Scottish Productivity Index Report investigates the key underlying factors that drive productivity through analysing economic data produced by the Fraser of Allander Institute (FAI).

One of the key themes was skills and training, which investigated the need for a cultural shift to lifelong learning in the workforce. The rising need for digital skills and continuous learning across the workforce is creating challenges for countries globally. The report found that technological skills are predicted to represent almost one-fifth of workers' time in 2030, regardless of their occupation. This highlights the requirement for wide-scale education in digital skills to ensure the workforce is keeping pace with technological change.

The report recommends government and business to set a target for 100% of the workforce to have basic digital skills by 2025. Academic institutions like schools, colleges and universities will require support to embed digital skills across every subject to ensure digital proficiency is achieved[176].

Digital Health and Care Institute

The Digital Health and Care Institute (DHI) forms part of the Scottish Funding Council's Innovation Centre Programme, designed to support transformational collaboration between universities and businesses. The Scottish acknowledge that, due to the nature of healthcare, the health sector is a complex environment with many different stakeholders and challenges.

The DHI publish short papers which summarise literature digital capabilities for the workforce, and in 2018 DHI released a paper investigating the skills in the Digital Health Sector[177]. Digital health in Scotland is one of the fastest growing economic sectors, largely due to the contributions of mHealth and health analytics; however, growth is being restricted by a lack of skilled employees, data access and data governance. The report found that the most important skills within digital health are software development, project management, and software/app development; however, these skills are rare. The sector is struggling to find suitably skilled graduates, and to offer them competitive salaries. There are also only a small number of courses offering digital health education in Scotland[178].

The report outlines 19 recommendations falling into three categories:

1. Better alignment of and more collaboration between the digital health sector and the education/training sector;
2. Raising the profile of the digital health sector in Scotland; and
3. Review of the existing education and training provision for digital health[179].

Digital Health and Social Care Strategy

The Digital Health and Social Care Strategy was developed in 2018. It looks at ways technology can shape and improve services through a person-centred model to improve outcomes across Scotland and outlines the initiatives and actions aimed at workforce capability to ensure the healthcare sector workforce is adequately prepared, supported and trained to work in the digital space.

> *"This strategy is bold, ambitious and enterprising and presents a once in a life time opportunity to create a digital and interoperable health and social care system, supporting improvement in the safety, effectiveness, efficiency and citizen-centred nature of the services we offer."*[180].

To enable digitisation of health and care service, the Digital Health and Social Care Strategy outlines a need for collaboration across the following six key domains:[181]

1. national direction and leadership;
2. information governance and cyber security;
3. service transformation;
4. workforce capability;
5. a national digital platform; and
6. a transition process.

The focus on workforce capability and skills across the entire health sector is recognised as critical to enabling the successful integration of digital health and care services. The strategy notes that strong leadership is needed to achieve this goal, and the use of information needs to be championed by stakeholders to improve decision making and service delivery. Executive and board-level roles such as chief digital officers, chief data officers, chief technology officers, and chief clinical information officers are now considered to be the 'norm' in most organisations. The expert panel highlighted that the most progressive countries in digital healthcare have dedicated senior leadership in conjunction with training in digital skills available to staff at all levels.[182]

To achieve the desired level of workforce capability, three key organisations have collaborated: the NHS Education for Scotland (NES), the Local Government Digital Office and the Scottish Social Services Council. This collaboration recommends a multifaceted approach to develop a modern workforce, which set out a number of key actions including:[183]

- Working with universities and colleges to integrate digital skills in education and training of the future workforce;
- Building the capacity and capability of ICT and data professions;
- Supporting a cohort of leaders to participate in the NHS Digital Academy Programme;
- Supporting nurses and allied health professionals through leadership programs and access to the Digital Champions Development Programme; and
- Sustaining continual professional development by growing a network of digital champions who will lead the change and inform developments and practice across the health sector.

Digital Participation Charter

The Digital Participation Charter is supported by NHS 24 and administered by the Scottish Council for Voluntary Organisations (SCVO), a membership organisation for Scotland's voluntary organisations and social enterprises. Its mission is to provide the Scottish population with essential digital skills to confidently use various digital services in order to 'do their jobs and live their lives'. It should be noted that this framework is not specific to health, but instead seeks to promote broad digital literacy.[184, 185]

Individuals, groups and organisations can sign up to the Digital Participation Charter and access targeted and specific training to become more digitally capable. Part of the initiative is an 'Essential Skills Toolkit' developed by the SCVO that allows for self-assessment of current digital capability. Guidance is provided to assist with interpretation of the results. This is supported by the Essential Digital Skills Framework.[186]

The Essential Digital Skills Framework includes four key areas that are considered to be 'foundation skills' such as:

- Problem-solving – finding solutions to problems using digital tools and online services;
- Communicating – communication, collaboration and sharing information online;
- Handling information and content – finding, managing and storing digital information and content securely; and
- Transacting – applying for services and managing transactions online.

There are a range of projects supported through the Digital Participation Charter Fund to help promote digital literacy across Scotland.

Scottish Centre for Telehealth and Telecare

The Scottish Centre for Telehealth and Telecare (SCTT) was established in 2011 and sat within the governance, management and reporting structure of NHS 24. In 2019 the SCTT stopped operating and NHS 24 took forward a number of digital health work streams. During its operating years the SCTT delivered lectures, tutorials and podcasts as part of their Knowledge Exchange and Workforce Development focus[187].

The aim of these activities was to raise awareness about technology enabled healthcare with academic staff and embed this into undergraduate programs and CPD modules. The activity was supported by sharing resources from SCTT directly with academic staff and increasing the number of higher education institutions who participate in SCTT knowledge-sharing events.

At a strategic level, SCTT worked with stakeholders to:

- Raise the profile of the impact of technology enabled services on the workforce across health and care at a strategic level;
- Highlight specific challenges and opportunities in relation to capability and capacity; and
- Support educational providers to share relevant information about technology in health and care training.

SCTT also developed a relationship with the Scottish College Development Network presenting to the Care Strategy steering group, providing content for training programs and delivering workshops on the topic of 'Digital Futures'.

Country profile: Canada

In Canada there is a current focus on electronic health records (EHRs) and electronic medical records (EMRs) as well as a growing move towards emerging technologies and their impacts on the health professions and specialities. The heavy investment and focus on these records have left a gap in the education of the workforce and risks a 'digital divide' emerging. This has become an area of focus among a number of health professions, with the Canadian Nursing Association calling for a review of the nursing curriculum to rethink how nursing students can be supported for a future in delivering care in a digital health environment.

Digital Health Canada's CEO, Mark Casselman calls out Rapid Learning as one of the top digital trends for 2019, stating that professionals today are expected to absorb an ever-increasing amount of information, and professionals will require ongoing support to enable this rapid learning[188] .

Digital Health Canada

Digital Health Canada was founded in 1975 to promote the effective use of information technology in health. The vision of Digital Health Canada has evolved since its inception, now known as a member-supported not-for-profit professional association that connects, inspires, and educates the digital health professionals.

Digital Health Canada supports health professionals to understand the value of becoming a Certified Professional in Healthcare Information and Management Systems – Canada (CPHIMS-CA)[189]. To achieve this Digital Health Canada provides two main health informatics courses to prepare participants:

- The Core HI Education (delivered life online and on-demand) which is comprised of eight modules; and
- The Custom HI Education (delivered life online and on-demand) which can be configured to fill specific knowledge gaps of participants and drill down to focus on specific projects.

A core component of the Digital Health Canada courses is ongoing professional development, with classes that provide a deep understanding of:

- The Canadian healthcare system;
- The critical topics underlying health informatics;
- How information technology intersects with healthcare leadership and management;
- The importance of privacy and security in healthcare delivery; and
- How to analyse and design the optimal system for any healthcare environment.

Digital Health Canada have also developed a career matrix and competencies, education and work experience required at differing levels of employment. The matrix is categorised by seven role domains:

1. Clinical and health services domain (example roles: chief clinical information officer, clinical informatics specialist and clinical informatics coordinator);
2. Canadian health system domain (example roles: chief information officer, eSafety manager, junior business analyst);
3. Project management domain (example roles: project services vice president, PMO manager, program coordinator);
4. Organisation and behavioural management domain (example roles: chief transformation officer, process improvement specialist and training coordinator);
5. Analysis and evaluation domain (example roles: chief knowledge officer, senior information analysis and data coordinator);
6. Information management domain (example roles: chief privacy officer, data architect and privacy coordinator); and
7. Information technology domain (example roles: chief technology officer, security specialist and service desk analyst)

The matrix is also structured across level of employment; emerging professional, competent level, proficient level, expert level and master level. Within each of these levels of employment the competencies are explored, along with education and work experience requirements.

Canada's economic strategy tables; health and biosciences

Canada ranks fourth in global health and biosciences hubs; however, there are challenges that need to be overcome in order to further advance Canada's global competitiveness. One of these challenges is the skills shortage and lack of access to executive-level talent.

The report suggests the future is a knowledge-intensive sector that fosters future-oriented skill development and delivers world-class research and development. The report recommends that the Government of Canada, the health and bioscience sector, academia and provincial/territorial governments need to work together to establish an empowered and accountable hub to drive the necessary changes to skills and talent programs, to ensure Canadians are equipped for the highly skilled jobs of the future.

One example of this partnership in practice comes from Queen's Medical School who partnered with the pharmaceutical industry to develop the Graduate Diploma in Pharmaceutical Management and Healthcare Innovation. This diploma is available to recent MD, PhD and PharmD graduates from across Canada to support industry needs by helping participants gain the necessary training and experience to transition to the private sector[190].

The report also suggests that federally funded programs should be streamlined to centralise skills development and training through a single body enabling efficient management of outcomes and reduced duplication[191].

Canada Health Infoway

Canada Health Infoway (Infoway) was established in 2001, as an independent not-for-profit organisation with a focus on working with partners to accelerate the development, adoption and effective use of digital health[192]. Infoway have leveraged significant advancements in digital health that have resulted in more than $26 billion in benefits for Canadians and the health system[193]. The 2017-18 annual report states that nearly 191,000 clinicians across Canada now use electronic health records (EHRs), which is an increase of more than 300 per cent in the past five years[194].

Infoway partnered with the Association of Faculties of Medicine Canada (AFMC) to develop eHealth competencies for undergraduate medical education, the following competencies were identified:

- Communicator - the ability to use and exchange data (through EHR/EMR) and communicate with patients and families;
- Collaborator - the ability to communicate and share electronic information with other healthcare professionals;
- Scholar - the ability to sustain and continually improve information and communication technologies to enhance patient care;
- Professional - the ability to define professional boundaries, obligations and responsibilities as they translate into eHealth practices;
- Health advocate - the promotion of physician advocacy with respect to humanism in the virtual health care workplace;
- Medical expert - the enhancement of medical expertise, using data and telehealth tools to support decision making;
- Leader - the leadership abilities in clinical service delivery including the accurate output from electronic health records[195].

Adopting eHealth solutions: implementation strategies

Due to the rapid advancement in technology and the changing expectations of the community, there are efforts being made to assist the healthcare sector to adopt what Canada terms as 'eHealth'. The *'Adopting eHealth Solutions: Implementation Strategies'* has been developed by the Registered Nurses Association of Ontario (RNAO) in partnership with Canada Health Infoway. The guidelines are intended to act as a key resource to help healthcare executives, nurses and other healthcare providers lead and support the implementation and adoption of digital health solutions across Canada.

This guideline provides a roadmap to integrate new technologies into professional practice and leadership competencies through evidence-based individual, organisation, education and system/policy recommendations.

The two most relevant elements of the guidelines are in relation to workforce capability are recommendations to:

- Enhance the capacity of all individuals involved in the implementation of eHealth solutions within a healthcare organisation; and
- To establish suitable infrastructure to support the eHealth education needs of the workforce.

It was suggested that healthcare organisations and academic institutions will need to establish an eHealth education and training infrastructure that provide opportunities for healthcare executives, nurses, and other health professionals to develop role-specific informatics competencies.

Health workforce digital capabilities being driven by professions/ medical specialties

As well as programs of work which seek to address the digital literacy across the whole of the health workforce, there are a number of initiatives that are being developed at a profession and or speciality level.

Canadian Association of Radiologists white paper on artificial intelligence in radiology

The Canadian Association of Radiologists (CAR) is the national specialty society for radiologists in Canada. The CAR created an AI working group with the mandate to discuss practice, policy and patient care issues related to the introduction and implementation of AI in imaging[196].

The white paper identifies a need to consider education in alignment with the introduction of AI in radiology. It was recognised that the role of the working group should be to provide expert, unbiased education to multiple different audiences, including; practicing radiologists, radiology residents, medical students, radiology and medical imaging researchers, industry partners, hospital and health care system administration and other clinicians, regulators and members of the public.

The white paper argues that practicing radiologists need to understand the value, weaknesses and potential errors that may occur when using an AI product to perform image analysis. A number of key education and workforce recommendations were suggested:

- The radiology community must be educated on how to critically analyse the output of AI and be able to identify errors or challenges as AI tools are introduced;
- The CAR must engage with regulatory agencies on the ethical and medico-legal issues concerning AI and play an active role in the advocacy of evidence-based principles in the evaluation and certification of radiology AI tools;
- The AI research and development community must address issues surrounding dynamic adaptive and active learning systems that may vary in prediction or performance over time and embed radiologist oversight over dynamic systems;
- The CAR should support and develop common standards for validation and testing of AI tools, emphasising stability of performance over varying settings, equipment, and protocols to certification for clinical use; and
- The development of applications that provide knowledge not widely available in the Canadian radiology workforce should be prioritised.

Pharmacy Practice and Digital Health report

In 2019 Digital Health Canada released a report on Pharmacy Practice and Digital Health. This report indicates that pharmacists have a role to play in becoming digital health coaches for patients requesting advice regarding health-related mobile apps and internet enabled monitoring devices[197].

The report provides an overview of:

- The current landscape of digital health as it pertains to pharmacy practice;
- Educational initiatives available to help pharmacists learn more about digital health;
- Current regulatory status of mobile health apps; and
- Patients' attitudes and any related benefits of using digital pharmacy tools and/or services.

Study of Digital Health in Canadian Association of Schools of Nursing (CASN): Curricular Content and Nurse Educator Capacity

> *"The design, implementation and use of information and communication technologies is considered fundamental knowledge among all health professions; to varying degrees, nursing students and practicing nurses are using ICTs to support care delivery"*

In 2003, less than 30% of schools of nursing reported having digital health content integrated into their basic entry-to-practice programs (theoretical or applied). The evolution and growth in adoption of digital health has prompted changes to the nursing curricular. Improvements have been driven by need, with digital informatics included in teaching curricular across the nursing colleges.

The study explores the state of integration between nursing education and digital health, as well as the existing knowledge of nurse educators in relation to digital health. Canada's health sector is rapidly adopting ICTs in all care settings, bringing a requirement for knowledge and skills uplift to ensure health care providers are able to safety utilise the new tools[198]. Digital health and informatics content have been found to exist in some but not all undergraduate nursing curricula within schools of nursing across Canada.

The study used a mixed methods engagement approach through surveys, telephone interviews and focus groups. The study found:

- There is a need for additional digital health/informatics awareness and education for both educators and administrators;
- There appears to be a disconnect between schools of nursing administrators and nurse educators in respect to their perceptions of educator capacity and the extent of digital health content integration; and
- There is a need for ongoing educator capacity building, a call for improved administrative supports and concrete strategies to guide future digital health curriculum integration within Canadian schools of nursing.

This study has revealed that while work is being done to prepare the incoming nursing health professionals to work within digital health, there is a lack of national standards and a siloed approach throughout Canadian universities with regard to curriculum. From the available literature, it is difficult to discern what initiatives there are to promote or enable continued professional development of current nursing healthcare professionals.

Organisations such as CASN, Infoway and the Canadian Nurses Association have all contributed significant investment to address the informatics and digital health learning needs of nurses across the country. Despite this investment, it was found that nurse educators have minimal awareness of the CASN informatics entry-to-practice competencies and other available digital health resources. It was identified that additional efforts need to be directed to support the Canadian schools of nursing administrators and educators to ensure the curricula is aligned with digital health practice requirements[199].

Country profile: Israel

Israel is considered a global leader in the digital health sector, with a strong foundation of digital health through its advanced and centralised health system, 98% of the population is covered by full health insurance and has been using the same linked EMR for a number of years. The four health maintenance organizations (HMOs) in Israel use the same EMR platform enabling access to patient records at each point of care as needed. This has resulted in a strong body of data about patients, care, and treatments[200].

There has been significant government investment into the advancement of the sector and support of digital health start-ups. In 2016 a total of $183 million was invested, with a strong focus on health analytics, with the subsector receiving 32% of the total investments[201]. The focus on digital health continued in 2018, with Prime Minister Benjamin Netanyahu's announcement of the establishment of a $300 million initiative for big data utilisation, to make anonymised data available to researchers, entrepreneurs, and medical institutions[202].

Israel is facing the challenge of an ageing workforce, with workforce shortages in certain physician specialities. There has been an increased focus on the structure and content of both undergraduate and graduate medical education to ensure alignment to the current and future needs of the medical workforce[203]. Israel is also challenged by significant intergenerational gaps in digital understanding and skills which, when combined with the challenges of an ageing workforce will need to be addressed through digital capability uplift programs to ensure the future of the health workforce in Israel[204].

National Digital Program of the Government of Israel

The government of Israel identified the need for a national digital policy in 2013, with the announcement of the Digital Israel National initiative which was promised to formulate and implement a national digital policy for using ICT. In 2017, the result of this initiative was the development of the National Digital Program, published by the Ministry for Social Equality. The program outlined the following goals:

1. Reducing socio-economic gaps; through bringing the geographic and social periphery closer reducing the cost of living and realising rights;
2. Accelerated economic growth; through advancing digital industries and businesses, developing the employment market in the digital age and supporting infrastructure development; and
3. Smart and friendly government; through national and local government accessibility, promoting innovative and effective government and improving public goods.

A number of core areas which were expected to experience significant digital quantum leaps were identified as focus areas within the National Digital Program, one of these being health. The program identified that ICT tools can improve the quality of health service in Israel through increasing efficiency and accelerating innovation in the health system[205].

Digital Health Strategy

The Israeli government announced their intention to invest $275m in its digital health strategy, in early 2018[206]. This strategy will coincide with the launch of a personalised digital database which will store information of up to nine million citizens in the country.

Over $170m is set to be allocated towards the development of essential digital platforms to support researchers. Approximately $64m will go towards the support of start-ups. Remaining funds will then support the overhaul of existing regulations to support the implementation of digital health[207].

Israel Innovation Authority

The Israel Innovation Authority is an independent publicly funded agency created to manage the country's governmental support of the resource of innovation[208]. The goal of the authority is to provide professional support and infrastructure to government efforts to encourage innovation in all industry sectors, complementing the major role that Israel already plays in the global high-tech sector[209].

The Israel Innovation Authority has three main roles:

- creating infrastructure to support diverse industries;
- developing tools and programs that suit the needs of the industry; and
- budgeting and financing high-risk projects and products.

In addition to these roles, the authority serves as a central hub for knowledge and consists of six customer-oriented "innovation divisions," each providing a variety of tools for each market segment and stage in the life cycle of a product: Technological infrastructure, advanced manufacturing, international collaborations, societal challenges, growth and early stage.

Digital Health Innovation Partnership

The Israel Innovation Authority, via the Israel-Europe Research and Innovation Directorate (ISERD), announced a partnership between Israel and Finland in the field of digital health. This pilot project will provide funding and matching services for Greater Helsinki-based and Israeli companies seeking to partner in order to co-develop, test, improve, or pilot impactful technologies, products, services and/or devices with strong market potential in the fields of digital health, smart mobility, and information and communication technologies (ICT)[210].

Aharon Aharon, CEO of the Israel Innovation Authority, said "Collaboration with Israeli companies will help Finnish start-ups access ground-breaking technologies that support the country's progressive health policies, protect Finnish citizens' well-being, and maintain Finland's status as a global leader in healthcare technology. This is also an extraordinary opportunity for Israeli companies to connect with Finnish leaders in the digital health ecosystem, gain exposure to new cutting-edge technologies, receive support for meaningful innovations, and tap into the Finnish market."[211]

Country profile: World Health Organization (WHO) in Europe

The World Health Organization (WHO) in Europe has invested a large amount into the research of digital health. In a publication from 2019 the WHO identified that digital health systems call for modified roles of healthcare professionals.

The adoption of digital health means that healthcare professionals will need to have the skills to use these new digital health tools, and to guide patients in understanding and using digital solutions to improve their health[212].

The WHO also suggests that digitisation will allow healthcare professionals more time to practice medicine, rather than making certain healthcare professionals redundant. For examples, technologies such as AI will assist in reducing the administrative burden on healthcare professionals allowing more time to practice medicine[213].

Securing a future for the hospital workforce in Europe

The Time to Care Report, on the hospital workforce in Europe, examines how the health care workforce is responding to the increasing demand for health care and the challenge of meeting demand with appropriately skilled staff.

The report suggested that technology will be the foundation for most aspects of care in the future, but care delivery will continue to require human capabilities such as creativity and social and emotional intelligence. Electronic health record systems are the most widely applied technology in health care; however, newer technologies such as AI, robotics and virtual reality are less well recognised for their health applications[214].

The scale and pace with which technologies are emerging means that the workforce will need to develop both the human and digital skills required for the future of health care.

A smart way to ease Europe's health workforce challenges

The Executive Director of the Austrian Public Health Institute and member of the European Health Forum Gastein's (EHFG) advisory committee, Herwig Ostermann, discussed the need to ensure necessary changes for health system sustainability with regard to the health work force and the roles of new technologies. Herwig Ostermann states that implementing digital innovation does not mean losing the human element, in fact it can mean the opposite:

> *"Some might fear that these disruptive technologies may simply replace humans and the person-to-person touch so vital in healthcare to ensure patient trust and personalised care. I would argue the contrary: implementing digital innovation does not mean losing the human element. In fact, technologies can improve humans' work by reducing paperwork, thereby giving professionals more time with patients."*[215].

Digital Health Roadmap European Union

In 2019 over 300 decision-makers, policy experts and researches from 50 countries attended the WHO symposium on the Future of Digital Health Systems to discuss the road forward for digital health. The symposium investigated the barriers that remain to the adoption of digital tools.

In her opening speech at the symposium, WHO Deputy Director-General Dr Zsuzsanna Jakab outlined some of these:

> *"We know that European decision-makers face multiple challenges when introducing innovation into health systems. These include allocating finances for the development of digital health services; integrating data across multiple, diverse systems; and ensuring that the health workforce is not only equipped to use technology but is also trusting and open to embracing the change that it inevitably brings."*[216].

The symposium concluded with Dr Hans Luge, Director of the Division of Health systems and Public Health at WHO/ Europe stating that the next steps to accelerate digital health in Europe is the development of a European roadmap[217].

Future skills and competences of the health workforce in Europe

The Joint Action on Health Workforce Planning and Forecasting investigated the driving forces affecting the future skills and competences of the health workforce and their implications.

The Joint Action uses horizon scanning to explore and describe the factors and forces, and their interrelationships in workforce systems. The aim of this horizon scanning is to:

- Increase our collective knowledge of the methods used to investigate workforce futures; and
- Demonstrate the application of futures methods to describe the factors and forces, and their implications, for health workforces and workforce systems[218].

The Joint Action conducted a future-oriented scan to 2035 for the driving forces influencing skills and competences of the health workforce in the EU. The scan investigated the extent to which disruptive technologies cause changes in the organisation of services and workforces. The scan also found that developments in the interoperability of electronic health records could affect the way that health workforces' access and engage[219]. The Joint Action found that systems thinking, and workforce planning skills and competence will be areas of increased demand for the future as our knowledge of their interrelationships develops[220].

DigitalHealthEurope

In 2019 DigitalHealthEurope launched the Horizon 2020 project to provide comprehensive, integrated and centralised support to the Digital Health and Care Innovation initiative in the context of the Digital Single Market Strategy[221].

The project aims to mobilise actions that boost innovation and advance the three Digital Single Market priorities for the digital transformation of health and care:

- citizens' secure access to and sharing of health data across borders;
- better data to advance research, disease prevention and personalised health and care; and
- digital tools for citizen empowerment and person-centred care[222].

DigitalHealthEurope's main objective is the deployment of digital solutions, the Horizon 2020 initiative includes a deployment support service which will include guidelines, checklists and documented successful approaches. The aim of this support service is to contribute to capacity building for the health workforce through defining the "building blocks" for the scaling-up of innovative practices.

IC-Health initiative

One of the Horizon 2020 projects is IC-Health. The IC-Health project aims to develop a series of Massive Open Online Courses (MOOCs) to help improve the digital health literacy of European citizens. The IC-Health objectives are to:

- Increase awareness among EU citizens of the opportunities of eHealth tools;
- Establish Communities of Practice on digital health literacy;
- Shape, facilitate and coordinate and organise the co-creation of overall 35 MOOCs – each one addressing one specific population cohort and being available in eight EU languages (English, French, Italian, Danish, German, Swedish, Dutch and Spanish) by at least 780 EU citizens;
- Test the MOOCs and assessing their impact on their health literacy, digital health literacy and on their health self-management;
- Advance the understanding of digital health literacy and of how it can be used to improve health outcomes[223].

The MOOCs will be co-created through communities of practice with specific population cohorts and groups of health professionals. This co-design will ensure the MOOCs are developed with the end user in mind.

Appendix B: Stakeholders Consulted

The Australian Digital Health Agency would like to acknowledge the important contributions of those stakeholders who made time available to participate in the consultation process to inform the development of this roadmap.

ACT Government
Ms Bettina Konti

ACT Health
Ms Kristina Carroll
Ms Sandra Cook
Mr Ryan Mavin

Australian Council of Deans of Health Sciences (ACDHS)
Professor Esther May

Australian Digital Health Agency
Dr Amandeep Hansra, Clinical Reference Lead

Allied Health Professions Australia (AHPA)
Ms Claire Hewat

Australian Health Practitioner Regulation Agency (Ahpra)
Professor Karen Crawshaw, Management Committee

Australasian Institute of Digital Health (AIDH)
Dr Louise Schaper

Australian Medical Association (AMA)
Dr Tony Bartone

Australian Medical Council (AMC)
Dr Julie Gustavs
Professor Eleanor Milligan
Associate Professor Jillian Sewell

Australia's National Digital Health Initiative (ANDHealth)
Ms Bronwyn Le Grice
Dr Jonny Lo

Australian Nursing & Midwifery Federation (ANMF)
Ms Julie Reeves

Australian College of Nursing (ACN)
Adjunct Professor Kylie Ward

Consumers Health Forum of Australia (CHF)
Ms Leanne Wells

Commonwealth Scientific and Industrial Research Organisation (CSIRO)
Dr Rob Grenfell, Health and Biosecurity

Commonwealth Department of Education, Skills and Employment
Mr Jason Coutts
Ms Carolyn Shrives

Commonwealth Department of Health
Ms Lynne Gillam

eHealth NSW
Dr Zoran Bolevich
Ms Petra Milnes

Health Consumers Council WA
Ms Pip Brennan

Macquarie University
Professor Johanna Westbrook

NT Health
Ms Nicolle Marchant
Ms Annette Stone

National Aboriginal Community Controlled Health Organisation (NACCHO)
Ms Donna Baker
Ms Michaela Coleborne

Pharmacy Board of Australia
Mr Brett Simmonds

Queensland Health
Professor Keith McNeil

SA Health
Mr Markos Chouris
Mr Bill Le Blanc
Mr Bret Morris

SkillsIQ
Ms Yasmin King

Swinburne University
Professor Nilmini Wickramasinghe

University of Melbourne
Associate Professor Kathleen Gray

University of Sydney
Ms Deb McGregor, University of Sydney and CDC

University of Tasmania
Associate Professor Kerryn Butler-Henderson

University of Technology Sydney
Professor Michael Woods

Department of Health and Human Services Victoria (Vic DHHS)
Ms Bronwyn Taylor

WA Health
Professor Peter Sprivulis

WA Primary Health Alliance (WAHPA)
Ms Learne Durrington

The Australian Digital Health Agency would like to acknowledge the important contributions of those stakeholders who made time available to participate in the jurisdiction workshops to inform the development of this roadmap. Workshops presented in order completed.

Aboriginal and Torres Strait Islander Affiliates Implementation Group – Brisbane Workshop

Aboriginal Health Council of South Australia (AHCSA)
Ms Carly Clyant

Aboriginal Health Council of Western Australia (AHCWA)
Dr Marianne Wood
Ms Jenny Sala

Aboriginal Health & Medical Research Council
Ms Rosemary Edwards
Mr Dean Wright

Aboriginal Medical Services Alliance Northern Territory (AMSANT)
Ms Mae Mae Morrison
Mr Simon Stafford

Australian Digital Health Agency
Ms Elizabeth Henningham
Dr Fiona Martin
Mr Brian Peacock
Ms Helen Purdy
Ms Gaby Suchard

National Aboriginal Community Controlled Health Organisation (NACCHO)
Ms Sarah Patrick

Queensland Aboriginal and Islander Health Council (QAIHC)
Mr Roderick Wright
Dr Kelly Dingli

Tasmanian Aboriginal Centre
Ms Coorinna Summers

Victorian Aboriginal Community Controlled Health Organisation (VACCHO)
Ms Karen Heap

Commonwealth Department of Health – Canberra Workshop

Ms Karen Cook
Dr Lucas De Toca
Ms Lynne Gillam
Ms Emma Glass
Mr Daniel McCabe
Associate Professor Zosh Pawlaczek
Mr Martin Rocks
Associate Professor Andrew Singer
Ms Valerie Spencer
Mr Ben Tomlinson
Ms Susan Wearne

Victoria Workshop

Allied Health Professions Australia (AHPA)
Mr Philipp Herrmann

Australasian College of Dermatologists (ACD)
Ms Belinda Jackson

Australian and New Zealand College of Anaesthetists (ANZCA)
Mr Anthony Wall

Australian Association of Practice Management (AAPM)
Dr Nicholas Voudouris

Australian Society of Anaesthetists (ASA)
Ms Jacintha Victor John

Eastern Melbourne PHN
Ms Narelle Quinn

Indigenous Allied Health Australia (IAHA)
Mr Paul Gibson

Murray PHN
Ms Bronwyn Phillips

North Western Melbourne PHN
Ms Bianca Bell

Royal Australasian College of Surgeons (RACS)
Mr Paul Cargill
Mr Ty Halse

Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG)
Ms Isaac Hanna

Tasmania Workshop

Department of Health and Human Services Tasmania
Ms Ruth Kearon
Ms Trixie Kemp
Mr Mitchell Arthur

Royal Hobart Hospital
Ms Shan Rodrigo

Tasmanian Health Service
Ms Jan Coull
Ms Kirsten Gibson
Ms Amy Glynn
Ms Marcin Gadzinski
Ms Kim Ford

Western Australia Workshop

Aboriginal Health Council of Western Australia
Dr Marianne Wood

Health Support Services WA
Mr Frank Patterson

Pharmaceutical Society of Australia
Ms Jocelyn Sisson

WA Health
Dr Rowan Ellis
Ms Jennifer Campbell
Professor Peter Sprivulis

Western Australia Primary Health Alliance (PHN)
Mr Simon Benge
Ms Bernadette Kenny

Brisbane Workshop

Aged Care Industry IT Council
Mr Gavin Tomlins

Australian Digital Health Agency
Ms Susan Emerson, Clinical Reference Lead

Bolton Clarke
Ms Georgina Casey

Brisbane South PHN
Mr Anthony Elliott

Bupa Australia
Ms Isobel Frean

Central Queensland, Wide Bay, Sunshine Coast PHN
Mr Randal Ing
Ms Ellen McDermott
Ms Charmaine Soboll

Darling Downs and West Moreton PHN
Ms Denise Pambid
Ms Renata Danisevska

eHealth Queensland
Ms Christine Coleshill
Ms Peta Gordon
Ms Tanya Harch
Ms Melissa McKnight

Emerson Health Pty Ltd
Ms Alicia Cook

Gold Coast PHN
Ms Bev Korn
Ms Yvonne Hermes

Health Television Network
Mr Paul Bennett

Metro North Hospital and Health Service
Dr Clair Sullivan

Qld Health
Mr Shaayaal Cameron
Ms Kristy Jackman
Mr Chris Keech
Ms Rebecca Shearman

Sydney Workshop

Australian Commission on Safety and Quality in Health Care
Dr Paul Miles
Mr Chris Boyd-Skinner

Australian Digital Health Agency
Mr Harry Iles-Mann, Clinical Reference Lead

Australian Medical Association (AMA)
Dr Michael Bonning
Dr Kath Browning Carmo
Dr Choong-Siew Yong

Australian Society of Anaesthetists (ASA)
Ms Jacintha Victor John

Central and Eastern Sydney PHN
Ms Yvonne Cheong Costa

NSW Health
Associate Professor Melissa Baysari
Dr Helen Freeborn
Ms Tamara Lee
Mr Dominic Trewick

Royal Australian and New Zealand College of Radiologists (RANZCR)
Ms Pamela Spoors

Sydney North Health Network
Mr Eric Dunn

South Eastern Sydney Local Health District
Dr Tony Sara

South Western Sydney PHN
Mr Sam Sio

Western NSW PHN
Ms Sonya Berryman
Mr Leigh Urquhart

Canberra Workshop

Capital Health Network
Mr Callum Campbell

Consumers Health Forum (CHF) of Australia
Ms Jo Root

Council on the Ageing (COTA)
Mr Corey Irlam

Cystic Fibrosis Australia
Ms Nettie Burke

Health Care Consumers Association (HCCA)
Mr Russell McGowan

Hepatitis Australia
Mr John Didlick

National Rural Health Alliance
Dr Gabrielle O'Kane

National Seniors Australia
Ms Janet Maccora

Parkinson's Australia
Mr Steve Sant

Universities Australia Health Professions Education Standing Group (HPESG) Workshop

UA Lead Vice-Chancellor (VC) Health Professions Education and HPESG Chair (Victoria)
Professor John Dewar, VC La Trobe University

Australian Council of Dental Schools (Victoria)
Professor Mark Gussy, Head, Dentistry and Oral Health, Director of Research, La Trobe University

Council of Pharmacy Schools Australia and New Zealand (Queensland)
Professor Peter Little, Dean of Pharmacy, University of Queensland

UA DVC Research Committee (WA)
Professor David Morrison, DVC Research, Murdoch University

DVC Tropical Health and Medicine (Queensland)
Professor Ian Wronski AO, DVC Tropical Health and Medicine, James Cook University (JCU)

Ex officio expert (Queensland)
Ms Pamela Stronach, Director Academic Quality and Strategy (Tropical Health and Medicine), James Cook University

Jurisdictional representative: NT
Professor Dominic Upton, Dean College of Health and Human Sciences, Charles Darwin University

Australian Council of Deans of Health Sciences (SA)
Professor Esther May, Dean Clinical Education and Equity (Health Sciences), University of South Australia

Australian Council of Nursing and Midwifery (NSW)
Professor Tracey Moroney, Head, School of Nursing, University of Wollongong

Medical Deans Australia and New Zealand
Currently vacant

UA Policy Analysts Group (NSW)
Mr Tim Payne, Director, Higher Education Policy and Projects, University of Sydney

Ex officio expert (ACT)
Professor Patrick Crookes, Professor of Nursing, University of Canberra

Jurisdictional representative: ACT
Professor Imogen Mitchell, Dean Medical School, Australian National University

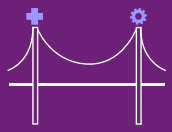
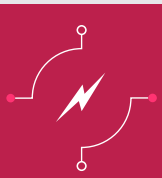
Universities Australia Policy Director Health & Workforce
Ms Rachel Yates

Appendix C: Existing workforce and education initiatives identified in consultation

Please note:

1. This appendix details key initiatives identified during the consultation process. The information presented is reflective of current initiatives. It is not a complete inventory.
2. This summary does not attempt to catalogue initiatives targeted towards those involved in education and research or education roles.

	Patient, Consumer and Carer	Frontline Clinical	Digital Champion
Existing Initiatives Identified in Consultation	• Consumers Health Forum have undertaken a survey to understand consumer views on digital literacy and digital expectations into the future.	• NSW Health and University of Sydney partnership to build digital literacy of frontline clinical workforce through online training program; • ADHA, AIDH and nursing and midwifery peak organisations work on digital capabilities for the nursing and midwifery workforce; • University of Tasmania work on allied health digital capabilities. • Digital health curricula or courses being developed/offered by University of Tasmania, Swinburne University, University of Melbourne, University of Sydney, Queensland University of Technology, Royal Melbourne Institute of Technology.	• None explicitly identified (however large scale IT implementations in health jurisdictions have started to develop this – for example AIM methodology used by NSW Health, and change programs to support large scale IT implementations (FSR project) in Qld Health)
Key Stakeholders	• National and jurisdictional consumer health advocacy groups; • Department of Health (Cwlth); • Australian Digital Health Agency	• All universities and RTOs providing frontline health clinical training (health curricula, and micro-credentialing focus) • National Boards and AHPRA, AMC, ANMAC (credentialing and CPD focus) • Professional associations	• Bespoke education and training providers offering change management and advanced training courses - including from IT system providers (e.g. Cerner)

 Clinical and Technology Bridging	 Technologist	 Leadership and Executive	 Business, Administration & Clinical Support
Existing Initiatives Identified in Consultation			
• CHIA course run by AIDH • HISA and Royal Australian College of Medical Administrators green paper on digital health; • Cert IV course in clinical classification; • Health Information Management degree offered by Queensland University of Technology and La Trobe University; • Health Information Workforce Census undertaken by researchers at University of Melbourne and University of Tasmania.	• While there are emerging qualifications coming through in information technology (Cert IV and Diploma in Cybersecurity, and Undergraduate, Postgraduate and Masters courses in Cybersecurity) there were no courses specifically flagged in consultation.	• Executive leadership courses in health jurisdictions are gaining increasing focus- for example South Australian Leadership Academy (however these don't necessarily have a digital focus).	• Noted that this impacts on wider industry segments (finance, human resources, procurement and business administration) impacts of future of work. No specific digital health education and training identified).
Key Stakeholders			
• Specialist professional associations (AIDH) • CPD and career pathways in medical specialities; • Universities and RTOs providing health information technology training (health curricula and micro-credentialing focus)	• Universities and RTOs providing information technology courses that are applicable to the health context. Increasing focus on new and emerging roles based on new technologies and advancements.	• Bespoke education and training providers offering executive leadership training that builds capability in digital health. Likely to be based on employer needs.	• Range of business and administration professional associations impacted who are expected to help drive change. Key focus on role redesign and education and training to support this.

Appendix D: Target setting and measurement – illustrative pharmacy example

Please note:

1. This appendix details key initiatives identified during the consultation process. The information presented is reflective of current initiatives. It is not a complete inventory. It is a draft illustrative model only and has not been agreed by any of the parties referred below. It will require ongoing consultation.
2. This summary does not attempt to catalogue initiatives targeted towards those involved in education and research or education roles.

Horizons	Objective	January 2021	January 2023	January 2026
H1: Digital Literacy Foundations	**A pharmacy workforce with a sound understanding of core digital health concepts**	• Baseline survey of current digital literacy completed – PSA • Digital literacy capability priorities identified – PSA and Agency • Webinars for digital literacy priority areas published – Agency • Agreement to integrate digital health foundations into National Competency Standards Framework (NCSF) - PSA • Agreement to integrate digital health foundations into pharmacy accreditation requirements – AACP • Digital health foundations integrated Digital Health Hub – PGA	• Progress survey of digital literacy completed – PSA • X% of pharmacy workforce demonstrate sound understanding in digital literacy areas • Integration of digital health foundations into NCSF – PSA • Digital health foundations integrated into VET Community Pharmacy training package – AISC / Pharmaceutical Manufacturing IRC / Skills Impact • Digital health foundations integrated into pharmacy accreditation requirements – AACP • Agreement to integrate digital health foundations into undergraduate pharmacy curricula – universities • Digital health foundations integrated into postgraduate curricula – universities	• Progress survey of digital literacy completed – PSA • 95% of pharmacy workforce demonstrate sound understanding in digital literacy areas • Digital health foundations integrated into VET delivery – RTOs • Digital health foundations integrated into undergraduate curricula – universities

PSA: Pharmaceutical Society of Australia | **NCSF**: National Competency Standards Framework | **AACP**: Australian Association of Consultant Pharmacy | **AISC**: Australian Industry and Skills Committee | **IRC**: Industry Reference Committee | **VET**: Vocational Education and Training | **RTO**: Registered Training Organisations | **PGA**: Pharmacy Guild of Australia | **PSML**: Pharmacy Shared Medicines List

Horizons	Objective	January 2021	January 2023	January 2026
H1: Digital Literacy Foundations (cont.)	**Consumer and patient-facing pharmacy workforce confident in the use of key technology systems**	• Stocktake of pharmacy technology systems updated – Agency • Software summary sheets for all key systems – Agency • Sandpits for key systems available for skills development – software providers	• Practical use of key systems integrated into VET Community Pharmacy training package – AISC / Pharmaceutical Manufacturing IRC / Skills Impact • Agreement to integrate practical use of key systems into undergraduate pharmacy curricula – universities	• Practical use of key systems integrated into VET delivery – RTOs • Practical use of key systems integrated into undergraduate curricula – universities
H2: New Technologies and Ways of Working	**A pharmacy workforce confidently using Pharmacist Shared Medicines Lists (PSML) to reduce medication interactions, which will help to improve both medicine safety and patient safety**	• Vendors engage with pharmacy user reference groups to design PSML integration – software providers • Vendors integrate support for PSML into key systems – software providers	• Software summary sheets for all key systems – Agency • PSML resources integrated Digital Health Hub – PGA	• 90% of community pharmacies connect and upload medicines information to PSML
	A pharmacy workforce confidently using ePrescribing to reduce medication interactions, which will help to improve both medicine safety and patient safety[1]	• Development of ePrescribing resources (summary sheets, videos, etc.) for readiness testing – Agency • Support readiness testing campaign – PGA	• Development of ePrescribing resources (summary sheets, videos, etc.) – Agency • Integrate ePrescribing into Digital Health Hub – PGA	• ePrescribing integrated into practical use of key systems in VET and undergraduate courses – RTOs and Universities

PSA: Pharmaceutical Society of Australia | **NCSF**: National Competency Standards Framework | **AACP**: Australian Association of Consultant Pharmacy | **AISC**: Australian Industry and Skills Committee | **IRC**: Industry Reference Committee | **VET**: Vocational Education and Training | **RTO**: Registered Training Organisations | **PGA**: Pharmacy Guild of Australia | **PSML**: Pharmacy Shared Medicines List

1. Does not consider workforce and education initiatives to support adoption by general practitioners, aged care providers and hospitals, etc.

Horizons	Objective	January 2021	January 2023	January 2026
H3: System Transformation	**A pharmacy workforce partnering with other providers of care to provide services (incl. tests and assistance with monitoring equipment and devices) to consumers and patients in the setting of their choosing**	• Establish research base to support pilot identification based on benefits – PGA and Agency • Develop initiative to test selected digitally-enabled new models of care – Agency and PGA	• Capability assessment of pilot cohort of pharmacists complete – PGA • Development of prototype solutions (minimum viable products) – software vendors • Targeted learning interventions for pilot cohort complete – PGA • Development of reference materials to support pilot – Agency	• Pilot initiative and evaluation of results completed - Agency

PSA: Pharmaceutical Society of Australia | **NCSF**: National Competency Standards Framework | **AACP**: Australian Association of Consultant Pharmacy | **AISC**: Australian Industry and Skills Committee | **IRC**: Industry Reference Committee | **VET**: Vocational Education and Training | **RTO**: Registered Training Organisations | **PGA**: Pharmacy Guild of Australia | **PSML**: Pharmacy Shared Medicines List

Glossary

The glossary below sets out abbreviations and definitions, including those specific to the Australian Digital Health Agency (the Agency). These terms are used consistently throughout this report to ensure continuity in the assessment.

Acronym	Term	Definition
ACHI	Australasian College of Health Informatics *now merged with the Health Informatics Society of Australia (HISA) to form the Australasian Institute of Digital Health (AIDH)*	
ADE	adverse drug event	An adverse drug event (ADE) is an injury resulting from medical intervention related to a drug. This includes medication errors, adverse drug reactions, allergic reactions, and overdoses[224].
AHCRA	Australian Health Care Reform Alliance	
AHCWA	Aboriginal Health Council of Western Australia	
AHIEC	Australian Health Informatics Education Council	
Ahpra	Australia Health Practitioner Regulation Agency	
AI	artificial intelligence	Technologies with the ability to perform tasks that would otherwise require human intelligence, such as visual perception, speech recognition, and language translation[225].
AIDH	Australasian Institute of Digital Health	
ALG	Accreditation Liaison Group	
AMRC	Association of Medical Research Charities	
ANZCA	Australian and New Zealand College of Anaesthetists	
ASQA	Australian Skills Quality Authority	
BP	blood pressure	
CALD	culturally and linguistically diverse	

Acronym	Term	Definition
CDSS	clinical decision support systems	Any system designed to improve clinical decision-making related to diagnostic or therapeutic processes of care. CDSS use specific parameters (such as diagnoses, laboratory results, medication choices, or complex combinations of clinical data) to provide information or recommendations directly relevant to a specific patient encounter at the point of care[226].
CHIA	Certified Health Informatician Australasia	CHIA is a unique credentialing program for health informatics. The CHIA credential demonstrates that candidates meet the health informatics core competencies to perform effectively as a health informatics professional in a broad range of practice settings[227].
COAG	Council of Australian Governments	
CPD	continuing professional development	Continuing professional development (CPD) is how health practitioners maintain, improve and broaden their knowledge, expertise and competence, and develop the personal and professional qualities required throughout their professional lives. Health practitioners who are engaged in any form of practice are required to participate regularly in CPD that is relevant to their scope of practice in order to maintain, develop, update and enhance their knowledge, skills and performance to help them deliver appropriate and safe care[228].
CPOE	computerised provider order entry	Refers to any system in which clinicians directly place orders electronically, with the orders transmitted directly to the recipient[229].
CRC	Cooperative Research Centre	
CSIRO	Commonwealth Scientific and Industrial Research Organisation	
	digital health	The definition of digital health has expanded from a narrow focus on eHealth to a wider view that encapsulates mobile health, wearable devices, AI, robotics, personalised medicine, telehealth and telemedicine, and innovative evidence-based products and services. Importantly, the understanding of digital health today extends beyond the use of electronic storage of data, to the active use of this data to inform service design and delivery. Digital health is a broad term and its definition will continue to change as new health technologies emerge. See section 1.4.

Acronym	Term	Definition
ECG	electrocardiogram	An ECG is a medical test that detects heart problems by measuring the electrical activity generated by the heart as it contracts[230].
EEG	electroencephalography	The EEG is a medical test used to measure the electrical activity of the brain[231].
EHR	electronic health record	EHRs contain information that can be managed, added to and accessed across multiple healthcare organisations[232].
	electronic system of record	A central authoritative source of data and information for a particular dataset. For example, electronic system of records includes medication prescriptions, patient records in a hospital, and patient immunisation information.
EMG	electromyography	An EMG is a diagnostic procedure to assess the health of muscles and the nerve cells that control them (motor neurons). EMG results can reveal nerve dysfunction, muscle dysfunction or problems with nerve-to-muscle signal transmission[233].
EMRs	electronic medical records	EMRs contain information that is created and resides within a single healthcare organisation (such as a clinic, medical centre, or a hospital)[234].
	electronic prescription	An electronic prescription is a prescription that is electronically generated and sent to a consumer's mobile phone or computer. An electronic prescription can be used in the same way as a paper prescription to obtain medicines from a pharmacy.
FFA	Framework for Action	The implementation plan for Australia's National Digital Health Strategy.
	health workforce	For the purpose of this roadmap the term 'health workforce' is defined to encompass 'all individuals who deliver or assist in the delivery of health services or support the operation of health care facilities'. For full definition see Section 2.2.
HEE	Health Education England	
HETI	Health Education and Training Institute	
HIMAA	Health Information Management Association of Australia	

Acronym	Term	Definition
HISA	Health Informatics Society of Australia *now merged with the Australasian College of Health Informatics (ACHI) to form the Australasian Institute of Digital Health (AIDH)*	
HPACF	Health Professions Accreditation Collaborative Forum	
HPESG	Health Professions Education Standing Group	
ILO	International Labour Organization	A United Nations agency whose mandate is to advance social and economic justice through setting international labour standards.
IoT	Internet of Things	IoT refers to a network of internet connected things that automatically collect and exchange data. This includes sensors that can measure temperature, record sounds, movement or images and send that data to other things. The value of IoTs are the insights derived and actions driven by the data that's collected and shared[235].
MOOC	massive open online course	MOOCs are free online courses available for anyone to enrol. MOOCs provide an affordable and flexible way to learn new skills, advance your career and deliver quality educational experiences at scale.
NACCHO	National Aboriginal Community Controlled Health Organisation	
NCVER	National Centre for Vocational Research	
NDHS	National Digital Health Strategy	
NHS	National Health Service	
NPS	National Prescribing Service	
OECD	Organisation for Economic Co-operation and Development (OECD)	
PHN	primary health network	
PPG	photoplethysmography	PPG is a simple optical technique used to detect volumetric changes in blood in peripheral circulation. It is a low cost and non-invasive method that makes measurements at the surface of the skin[236].

Acronym	Term	Definition
PSML	Pharmacist Shared Medicines List	The PSML is a list of medicines that may include those prescribed by your doctor, non-prescription medicines including over the counter or complementary medicines (such as vitamins or herbal medicines) you may take. This list will include details on how and when you take your medicines at the time the list was created[237].
RANZCR	Royal Australian and New Zealand College of Radiologists	
RCPA	Royal College of Pathologists of Australasia	
	system of record	The authoritative data source for a given piece of information (for example a patient record system linked to My Health Record)
TDSS	treatment decision support system	TDSS programs allow patients to actively engage in the healthcare decision-making process by gathering and weighing information which may be personalized for their situation[238].
VET	Vocational Education and Training	

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