Empowering the health workforce

Strategies to make the most of the digital revolution

OECD

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Summary and Recommendations

Digital transformation in the health sector is not a simple matter of technical change, but requires adaptive change in human attitudes and skills as well as of legal frameworks and the organisation of work

Digital technologies offer unique opportunities to strengthen health systems, as illustrated once more by the COVID-19 pandemic, when the use and oftentimes remarkably fast deployment of various digital tools and solutions has allowed countries to better detect and prevent the spread as well as to respond to the pandemic. In general, digital health technologies can help meet the challenge of both the changing health needs of the public and the ever tighter fiscal space.

In the health sector, the potential benefits of digital technologies are abundant. Ensuring access to the right information by the right people at the right time can improve safety, effectiveness, and efficiency of care. Digitally enhanced health services can improve access and help move away from reactive towards proactive approaches to preserving health. Health workers could be relieved from time-consuming routine tasks and interact better with patients. Patients could become more engaged, improve self-care skills, and more effectively co-produce health.

However, despite some isolated successes as well as the recent acceleration in uptake of digital technologies achieved during the COVID-19 pandemic, the health sector is a long way behind other industries in reaping digital opportunities. Investment in technical infrastructure plays an important role and is often insufficient, but even an ideal technical infrastructure will not guarantee a success.

Successful digital transformation in the health sector is not a simple matter of technical change but requires a complex adaptive change in human attitudes and skills as well as in the organisation of work and the related legal and financial frameworks. Digital technologies only provide the tools and cannot transform the health sector on its own but need to be put to productive use by the health workers and patients.

Many health workers already use some digital tools and solutions in their day-to-day work and perceive the benefits that they bring to them and to patients. However, many also question the value digital technologies produce in health care or complain about technology getting in the way of their work. Moreover, health workers often report not having opportunities for the up-skilling required to put the technology to full use or that the legal, financial, and organisational aspects of work – designed in the pre-digital era – are not adequately reformed to enable the technology to add value. The workers and patients also demand appropriate safeguards against potential undesired effects of the use of digital tools, including the possible lack of transparency or threats to data privacy. If unaddressed, these concerns are not only likely to result in additional inefficiency and waste, but also place undue burden and strain on the workers.

To address these barriers to successful digital transformation governments will need to provide the necessary political leadership and implement a range of policy actions to support three main objectives:

1. **building trust in the benefits of digital transformation** among health workers and patients while minimising any risks;
2. **advancing expertise and skills** needed for effective use of digital health technologies;
3. **adapting the organisation of health service delivery and the related legal and financial frameworks**.

1. Governments need to provide foundations for trustworthy, ethical, and human-centred digital transformation

1.1. Providing leadership with an overarching and human-centric digital health strategy

A successful digital transformation amounts to a health-system-wide reorganisation, and, as such, it requires leadership with an **overarching strategy that articulates how technology-driven innovation strengthens health systems and forms a framework for coordination among all the decision-making actors**, where the parties agree to continuously prioritise specific initiatives. A good digital strategy illustrates how digital technologies can provide solutions to problems that health workers encounter in their daily jobs; in particular, it defines focus areas for achieving the objectives of putting patient needs first and making daily workflows easier.

The strategy should also form a part of a broader cross-sectoral digital strategy in order to support joint initiatives in the areas where there are interdependencies across different sectors, such as health and education.

1.2. Advancing evaluation and regulatory safeguards to ensure positive impact of digital technologies

The transformative potential of digital technologies implies huge prospective benefits but also risks and the possible diversion of resources to ineffective digital tools. Hence, their implementation needs to be accompanied by robust evaluation and monitoring to assess their true impact on prevention and health care. This is particularly the case for more disruptive technologies, such as Artificial Intelligence, for which knowledge about the consequences is limited when first implemented and any undesired effects cannot be fully anticipated and averted. Once a technology is widely used, the consequences become known, but it might be difficult to adapt the technology or the legal and organisational environment to timely counteract any undesired effects.

Depending on the technology, there are two solutions to the above problems:

- to increase knowledge of benefits and risks at initial stages of the development and use of a new digital technology. This can be realised through **advancing the methods for systematic evaluation of the impact of digital health technologies**, which, at present, are largely based on methods primarily developed and used for pharmaceuticals
- to increase social control over technological trajectories through **regulatory safeguards and monitoring for digital technologies**, Artificial Intelligence in particular, during their life-time.

1.3. Promoting user-friendly design of digital technologies

The usability of digital technologies is one of the major drivers of the adoption. Yet, the experience to date shows numerous examples of technologies that instead of aiding the work of health professionals, get in its way. Most challenges result from a failure to adequately engage end-users in the design process and understand the complexity of work in health care, despite the existence of well-developed methods that can aid such engagement and understanding.

Hence, there is a need to further **strengthen regulations regarding technology design, such that producers face incentives to meaningfully engage with the end-users** and the public procurement of digital tools and solutions includes user-friendliness among the selection criteria. Countries can also consider issuing **guidelines for the producers** or **collecting information on user experience with digital technologies** to improve knowledge of problems and inform work on improvements.

2. Human expertise and skills need to be advanced to enable digital technologies to add value

2.1. Including digital skills in the core content of health education and professional training

Digital health is frequently only available as an elective course in education or professional training programmes and not taught at a high enough level. Moreover, it is presented as a standalone subject rather than being integrated across subjects, which is not conducive to building a digital culture or the perception of digital technologies as an integral component of health services.

This calls for **ensuring the presence of digital health in the core content of education and professional training** as well as **investment in creating modern and comprehensive digital-health curricula** for future and current health workers. The curricula should not only focus on skills for merely operating digital tools, but also on skills such as critical appraisal of information and digital health ethics.

To meet the current demand for digital up-skilling more **systematic support should be created that ensures up-skilling for all categories of health workers**, in particular through **more flexible (self-) learning opportunities**. The prevailing problems of Continuous Professional Development (CPD) and other professional training systems, such as a lack of dedicated time or means for up-skilling on the part of health workers, need to be also addressed.

2.2. Merging of ‘high-tech’ and ‘high-touch’ skills

While digital technologies have allowed for means of social connection that have not been possible before, they can also often cause a deterioration in the quality of social interaction. Therefore, the **development of specific interpersonal skills, particularly in patient-centred communication and shared patient-provider decision-making,** needs to be further emphasised in health education and training.

Moreover, experience from other industries illustrates that the emerging digital tools based on developments in Artificial Intelligence will **require skills in counteracting automation bias**, i.e. the phenomenon of favouring suggestions made by automated systems, while ignoring other sources of information. The health education sector needs to acknowledge this problem and invest in work on training devised to tackle it.

2.3. Creating a larger cadre of individuals with hybrid skill-mix to manage the transformation

Addressing the critical challenges of digital transformation requires policy makers and technologists as well as clinical leaders/managers and technologist to work together and understand more of each other’s fields. However, health systems lack **clinician-leaders and managers with a combined understanding of clinical practice, technology, and change management**. There is also evidence of a deficit of **informaticians and system optimisers with strong insights into health care**.

This requires more of the **joint degree and hybrid educational programmes** that combine the understanding of, for example, clinical practice, technology, and change management or health policy, ethics, and technology. The programmes at the executive and postgraduate levels should attract professionals who are already pursuing a career in, for example, clinical practice or digital technology.

3. Existing models of health service delivery and the related legal and financial frameworks need to be adequately and timely adapted

3.1. Developing structures inside governments to incubate new approaches and ensure the timely revision of laws, payment systems, and organisational frameworks

Digital transformation is critically dependent not only on the increasingly widespread presence of digital tools and solutions in the health sector, but also on whether their presence results in the **development of new forms of cooperation and models for how health services are provided**. The new ways of working, however, might not fit within the **existing legal, financial, or organisational frameworks**, which **need to be adapted such that the health systems can quickly start using the novel solutions**.

New digitally-enabled health services, for example, need to be adequately recognised in provider payment systems. Similarly, if digital technology augments health workers' tasks and roles, regulations need to timely allow for expanding or reassigning these tasks and roles. The implementation of digital technologies by health care organisations needs to be planned, as, in most cases, it takes a considerable amount of time of front-line health workers, which must be accounted and allowed for.

3.2. Matching skills supply and demand

Creating the joint degree and hybrid educational programmes to build a larger cadre of individuals with hybrid skill-mix to manage digital transformation will not bring much, unless the supply of such skills is matched by demand for these professionals among health care organisations and other institutions within a health sector. Without the availability of full-time jobs with a sustainable career track, few talented individuals will choose, for example, to leave the practice of medicine, nursing, or pharmacy to obtain additional training and certification in digital technology. The same applies to informaticians or system optimisers, who will not be interested in obtaining additional knowledge of health care, if the sector does not offer attractive jobs for them. Similarly, positions for professionals combining expertise within the field of health systems management and digital technologies will need to be created within the organisations governing the health sector.

Therefore, **strategic, coordinated and sustained resourcing is needed to ensure new positions for individuals with hybrid skill mix are available** within the health sector and offer attractive career paths.

3.3. Including the digital future in health workforce planning

Workforce planning in the health sector is particularly important, given the time and cost involved in training the main categories of health professionals. Health workforce planning should not only guide policy decisions on entry into health education programmes, but also assess the workforce implications of possible re-organisations in health service delivery, as driven by the adoption of digital innovations, among other factors. Hence **a successful digital transformation requires also that health workforce planning takes into account the future digitally-enabled care models**.

Introduction

On average today, the health systems consume a tenth of the respective national incomes, with the growth of health expenditure outpacing economic growth for most of the past half century (Lorenzoni et al., 2019[1]) – a trend that is likely to persist in the future, especially considering the impact of the current COVID-19 pandemic. More efficient spending, whilst still improving the access to and the quality of health services, is a key policy challenge.

In this context, digital transformation offers unique opportunities to strengthen health systems and meet the challenges of responding to the changing health needs of the public and health workforce shortages. Many sectors in the economy have already transformed their business models for the digital era, resulting in better products and services, more efficient processes, as well as lower prices and easier access to goods and services for consumers (OECD, 2019[2]).

In the health sector, the potential benefits of digital technologies and digitally-driven process innovation are abundant. Ensuring access to the right information by the right people at the right time can improve safety, effectiveness, and efficiency of care. Digitally enhanced health services can improve access and help move away from reactive towards proactive approaches to preserving health. Health workers could be relieved from time-consuming routine tasks and interact better with patients. Patients could become more engaged, improve self-care skills, and more effectively co-produce health (Figure 1) (OECD, 2019[3]). During the COVID-19 crisis, the use and oftentimes remarkably fast deployment of various digital technologies have provided countries with tools to better detect and prevent the spread as well as to respond to the pandemic.

Figure 1. The potential benefits of digitally-driven innovation in the health sector are abundant

More effective, efficient, and people-centred services
faster access to critical information
more proactive approaches to preserving health and better patient involvement
clinical process optimisation

More accurate surveillance and enhanced resilience in the face of crisis
faster detection and better reponse to public health emergencies, e.g. the COVID-19 crisis
better public health interventions

Better health system management
monitoring of health system performance
better resource allocation
enhanced planning and access to care

Powered-up research & innovation
analysis of vast amounts of data for better diagnostics and treatments
real-world evidence for assessing long-term effects of therapies

Yet, implementing digital technologies is not a simple matter of technical change. A successful digital transformation requires a complex adaptive change, particularly in human expertise and skills, as well as in the organisation of work and the related legal and financial frameworks.

Many health workers already use some digital tools and solutions in their day-to-day work and perceive the benefits that they bring to them and to patients. However, many also question the value digital technologies produce in health care or complain about technology getting in the way of their work. Moreover, health workers often report not having opportunities for the up-skilling required to put technology to full use or that the legal and organisational aspects of work – designed in the pre-digital era – are not adequately reformed to enable the technology to add value. The workers and patients also demand appropriate safeguards against potential undesired effects of the use of digital tools, including the possible lack of transparency or threats to data privacy.

In order to enable a successful digital transformation of health systems and overcome barriers governments need to provide the necessary political leadership and implement a range of policy actions to support three main objectives:

- build trust in the benefits of digital transformation among health workers and patients while minimising any risks, which requires guaranteeing proper assessment of technology;
- advance the expertise and skills needed for the safe and effective use of digital health technologies;
- adapt the institutional environment – i.e. the legal, financial, and organisational frameworks – to enable the full potential of the technologies.

This report consists of three parts: Chapter 1 serves as a background and outlines how digital technologies can help to address existing and emerging health policy challenges as well as how far the EU and OECD countries are in seizing these opportunities; Chapter 2 discusses the health-workforce-related barriers and enablers to successful digital transformation; and Chapter 3 describes a set of actions governments can take to activate the enablers and remove the barriers with the aim of empowering health workers to make the most of the digital revolution.

1 Digital transformation of the health systems – State of play

KEY MESSAGES

Digital transformation offers unique opportunities to strengthen health systems and meet the challenges of responding to changing health needs, such as the current epidemics of infectious and chronic diseases.

Still, the health sector lags behind other industries in seizing the opportunities brought by digital technologies. Despite considerable efforts and some promising national successes, health systems in most of the EU and OECD countries still have not undergone digital transformation:

- **Different datasets and services still are not linked electronically, hindering the flow of crucial information** – a serious problem, for example, during the COVID-19 pandemic.
- **The use of telehealth and mHealth solutions is limited**, often only to exceptional circumstances, **despite growing evidence of general benefits**, hampering progress in bringing care closer to the patients, improving access, and moving away from reactive towards proactive approaches to preserving health.
- **The use of analytics employing diverse data and technologies such as Artificial Intelligence is only slowly emerging**, despite the complexity of health-sector processes and activities and the ensuing high reliance on multifaceted information to solve problems.

The barriers to progress are not only technical, **but also institutional and organisational**. While the **governments need to commit to continuous investment in interoperability and building of flexible digital architecture**, they also need to **ensure timely modernisation of policy and governance frameworks**. The most pressing areas include:

- ensuring effective cross-sectoral approaches and policies;
- avoiding delays in adjusting legislative and financial frameworks for the digital era;
- providing adequate support for health workers.

This Chapter outlines how digital health technologies (Box 1.1) can help to address existing and emerging health policy challenges and how far the EU and OECD countries are in seizing these opportunities.

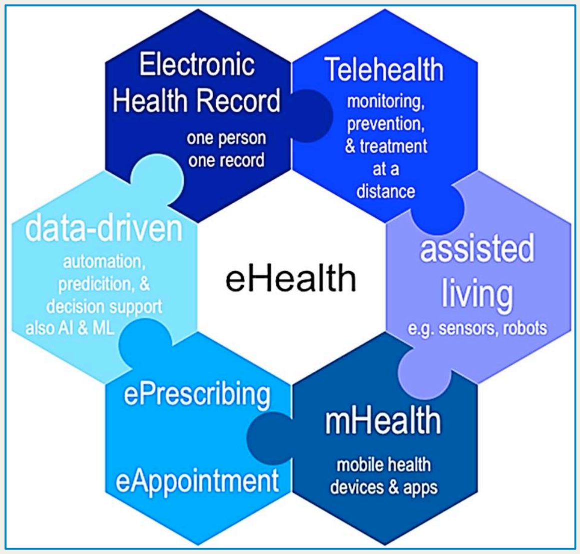
- 1 provides an overview of the most prevalent use of digital technologies in the health sector, i.e. the electronic data communication systems.
- 2 discusses telehealth and mHealth solutions, including remote health monitoring, the use of health apps, and assisted living technologies, such as robot-assisted therapies or novel devices that allow diagnostics and therapy at home.
- 3 describes developments in automation, prediction, and decision support, including technologies such as Artificial Intelligence.

Box 1.1. Defining digital health (eHealth)

Digital technologies refer to electronic tools, systems, devices, and resources that generate, store, process, and/or transmit data. These range from equipment such as computers and smartphones to intangible products such as software, web-based platforms, and algorithms, e.g. Artificial Intelligence. Digital technology is used interchangeably with **information** (**and communication**) **technology** (**IT** or **ICT**).

Electronic Medical and **Health Records** (**EMR** and **EHR**) contain a range of an individual's health data in digital form. An **EMR** is created in a service or an organisation that delivers health care, e.g. a hospital, while the **EHR** moves from an institution-centred to a person-centred digital record that ideally contains the entire history of an individual's interactions with the health system regardless of the settings, service, or organisation. EHRs often include systems allowing **ePrescribing** between the prescribers and dispensing pharmacies and **eAppointments** for booking consultations online.

Telehealth involves a combination of digital solutions that allow for delivering clinical services and monitoring of care and treatment at a distance and – where appropriate – asynchronously, i.e. with the involved health worker(s) and the patient connecting at different points in time, which creates additional flexibility. Telehealth often includes the use of mobile health devices and digital health apps (**mHealth**).



mHealth, short for 'mobile health', on the one hand, refers to the use of generally available mobile (communication) devices such as smartphones or tablet computers, and wearable devices such as smart watches, on which digital health apps and sensors operate. On the other hand, it also includes mobile devices produced specifically for the use by health care providers for services provision and data collection, such as portable monitoring systems.

Assisted-living technologies – combinations of digital health apps and other software, sensors, and sometimes robots that aid, for example, mobility and independence of the elderly, people living with disabilities, or patients in home-based therapies. The main aim is to enable patients to be in their own homes and live independently longer or to return to their homes faster after a hospital treatment.

Data-driven automation, prediction, & decision support – analytics employing data and technologies such as **Artificial Intelligence** (**AI**). AI is a machine-based system that can, for a given set of operator-defined objectives, make predictions and recommendations. AI systems are designed to operate with varying levels of autonomy. **Machine learning** (**ML**) allows digital systems to achieve objectives without being given explicit instructions as to how, but by analysing patterns in training data, which has to be prepared adequately, including or excluding labelling. **Deep learning** is the subfield in which the digital system achieves this objective by hierarchically determining distinguishing features of the data sets.

1. Current use of existing data and interoperability across segments of health systems

For many health sector challenges, the most appropriate digital solutions often involve the simple but effective use of the data that is already being collected; in particular, through linking data across the many organisations, units, and devices that collect them, such as hospitals, physician offices, pharmacies, laboratories, bio-banks, statistical offices, or medical devices and apps. This harbours abundant opportunities to improve health and health policy outcomes (Figure 1.1).

Figure 1.1. Better use of existing data harbours abundant opportunities

Better use of existing data	
	giving all providers access to comprehensive, consistent, and timely information about patients to promote **more effective, safer, and better coordinated care**
	empowering people to take part in their own care and treatment, understand their health condition, and communicate with their health care team more effectively
	better targeting of more personalised interventions at the persons most likely to benefit from them, while avoiding treating others unnecessarily
	improving public health monitoring and enabling **more effective responses to public health emergencies**, such as the COVID-19 pandemic
	identifying waste, inappropriate practice, and inefficiency to improve policy making, system governance, and stewardship, including better funding and remuneration
	assessing and comparing the long-term performance of biomedical technology and treatments, and evaluating new treatments and practices

Source: (OECD, 2019[3])

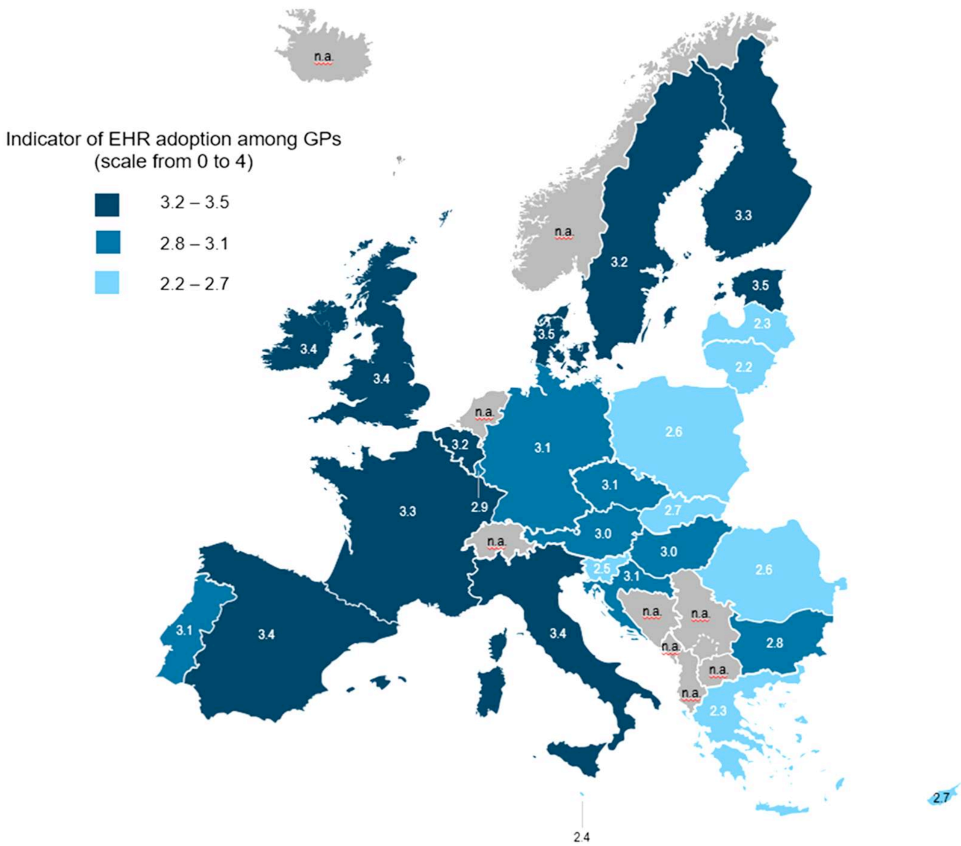
1.1. Health data often remain segmented across the health system and underused

Over the past two decades, the EU and OECD countries have made a tremendous effort in creating and improving electronic records and databases within their health systems. At present, at least some of a number of key national (or regional) health datasets, such as hospital in-patient data, emergency health-care data, primary-care data, formal long-term care data, or prescription-medicines data are available and used in the day-to-day practice of health service delivery in the majority of the countries. In the last five years, for example, the availability and quality of the national primary-care datasets have significantly improved owing to the more widespread adoption of EHRs among general practitioners (GPs), although some countries continue to lag behind (Figure 1.2) (European Commission, 2018[4]).

However, the datasets of different segments of health systems within a country still do not communicate with each other electronically. In effect, it often falls on patients – or their relatives – to carry and repeat information about their care and treatment history through the health system, and health workers are still waiting for an easier workday where the right information is readily available at the right time (OECD, 2019[3]). These critical shortcomings have been once more brought to light with the outbreak of the COVID-19 pandemic, with, on the one hand, hospitals having to ask the patient – if at all possible – for information on comorbidities and, on the other, the health systems struggling to follow up on the full spectrum of the developments in real time, also with regard to health outcomes of suspected cases or patients who were not hospitalised.

Figure 1.2. EHR adoption by General Practitioners in the EU

The score reflects the share of GPs who indicated the following state of EHR use in their practice:
0 = not aware; 1 = do not have it; 2 = have it but do not use it; 3 = use it occasionally; 4 = use it routinely.



Source: (European Commission, 2018[4])

From a health system's viewpoint, such a situation is not much better that the pre-digital equivalent of paper records stored by individual health care organisations and practices (OECD, 2019[2]). Consolidating the facts about an individual across different organisations is a key structural component of a high-quality health system (Auraaen, Slawomirski and Klazinga, 2018[4]). This can mean either a 'one patient one record' approach or one made up of disparate platforms that are set up to exchange data and information in a secure and unencumbered way, e.g. through a joint access portal. Estonia has been the first EU country to fully implement one of the former systems in the early 2010s (Box 1.2), followed by a number of other countries, such as Finland, Luxembourg, or Sweden (OECD, Forthcoming[5]).

The *2019/20 OECD Survey of Health Data Development and Governance* reveals that many countries continue to face challenges with regard to linkages between the key national health datasets[1]owing to

[1] The survey examined the development and use of 13 key national health datasets: Hospital in-patient data, Mental hospital in-patient data, Emergency health care data, Primary care data, Formal long-term care data, Prescription

either a lack of effective cross-sectoral approaches or delays in adjusting legislation and regulations for the digital era. The number of custodians of key national datasets is a contributing factor to whether or not dataset linkages are regularly undertaken or common standards adopted across the datasets. Moreover, different patient/person ID's are used among the datasets, which severely obstructs dataset linkages. In addition, many countries report issues with data quality, such as limited population coverage (due to, for example, the non-inclusion of data from private providers and insurers) or a significant time lag between when the data are first recorded and when they become part of the national dataset. The *Survey* also reveals that in most countries, available key national healthcare datasets continue to have some mixture of data entry from paper records and data extracted automatically from electronic records. The Czech Republic, Slovenia, and Sweden report that all datasets rely to some extent on data extracted automatically from electronic clinical data and/or electronic insurance claims or billing data (OECD, Forthcoming[5]).

Box 1.2. Shifting from institution-centred to person-centred electronic records – Estonia's EHR

Estonia became the first country in the EU to fully shift from institution-centred to patient-centred electronic records, which cover an individual's history of all contact with the health system from birth to death regardless of the setting, service, or organisation (including diagnostic images, test results, and prescribed medications). In 2009, Estonia implemented a health information exchange, into which all health service providers, regardless of public or private ownership, must upload patients' data from their own systems.

An opt-out mechanism allows patients the right to partially or completely restrict access to their EHRs. Patients can view their EHRs by logging onto Minu e-tervis (My eHealth) using an electronic identification card or a mobile phone ID. Patients can see who is accessing their data – each access is logged by the system – and have the legal right to ask why their data is being accessed. Patients can also interact with their data by updating their details, supplementing existing information, and carrying out administrative processes, such as obtaining a medical certificate for a driver's license without needing a specific face-to-face appointment.

My eHealth belongs to a broader public e-services portal eEstonia, which includes also eTaxes, eSchools, eCommercial registries, and eElections, among others. One of the key elements of eEstonia is that its databases are decentralised and distributed in a flexible service-oriented architecture so that new services can be added as and when appropriate. These decentralised databases, including those for health, are linked to each other through the public ICT infrastructure of the government, which allows searches and transfers of large data sets to be performed across the different databases and can be flexibly scaled up as new databases come online.

Source: (WHO, 2016[6])

1.1.1 Patients do not always have access to their (full) health data electronically

The majority of countries have been implementing ways for people to access their health data electronically. However, without person-centred EHRs, patients necessarily cannot see their full health data in one place. Moreover, patients continue to have limited access even to their EMRs within each sector of a health system (OECD, 2019[2]).

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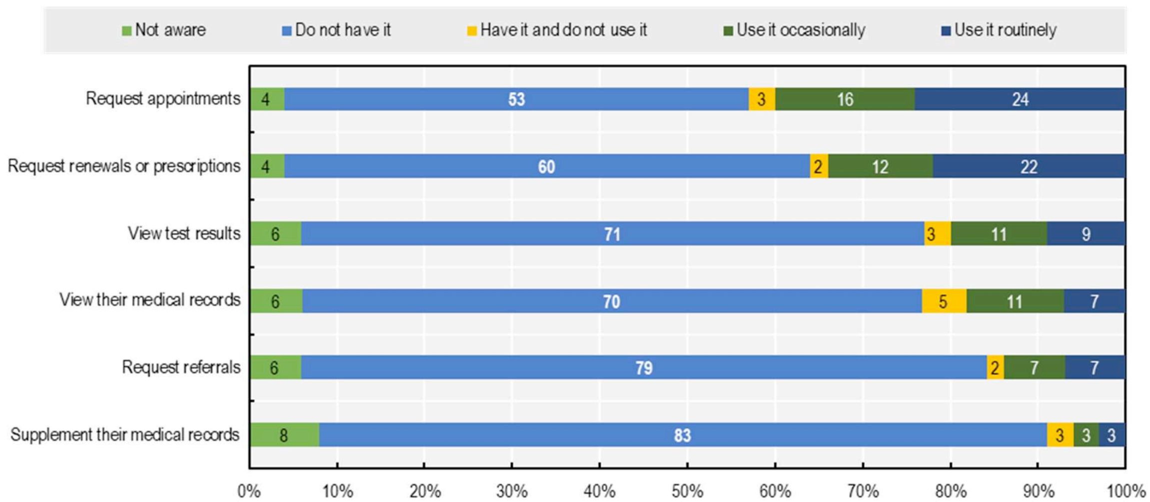
medicines data, Cancer registry data, Diabetes registry data, Cardio-vascular disease registry data, Mortality data, Patient experiences survey data, Population health survey data, and Population census or population registry data.

In primary care, for example, the most recent survey among GPs across the EU, indicated that viewing medical records or test results was available to patients in only around a quarter of the GPs practices (up from around 10% in 2013) (Figure 1.3). The functionality most often available to the patients is online booking of appointments. Still, only around half of the GPs reported to have it (European Commission, 2018[7]).

Figure 1.3. Patients across the EU have limited access to their primary care medical records

Functionalities available to patients in primary care medical records, as reported by the GPs



Source: (European Commission, 2018[7])

1.1.2 Regular use of data for monitoring, performance improvement, and research is not yet a norm

Regular deployment and linking of health data for secondary purposes, such as to report on health systems performance, is increasingly adopted but relatively less common than the primary use of the data in the day-to-day provision of health services. Around a third of the countries report, for example, publishing of indicators on unplanned hospital re-admissions, mortality at intervals after a given procedure, survival after diagnosis/treatment, or appropriate prescribing of drugs (OECD, Forthcoming[5]).

The use of existing data to inform improvements in service delivery – through, for example, designing more tailored or better coordinated services – remains rare. While many countries pilot small projects aimed at an evidence-based redesign of health services, few implemented new care models on a larger scale (OECD, 2019[8]). In Spain, for example, a locally developed risk-stratification tool, exploring medical-records data of primary care providers and hospitals, is used in 14 of the country's 17 autonomous regions. The tool is used to identify and group patients with complex care needs to improve targeting of care and allocation of health-system resources. The regions have built on this tool to tailor-design integrated care models for each group of patients with complex care needs. Such models disencumber overburdened providers, for instance, by reducing unnecessary hospitalisations and the administrative workload of primary-care physicians (OECD, 2019[8]).

Moreover, there are also missed opportunities with regard to collecting data on patient-reported outcomes (PROs) of care. As discussed above, digital technologies can help move away from reactive towards proactive approaches to preserving health by enabling greater participation of patients in the care process.

Enabling patients to take part in their care also includes collecting data on PROs, which in turn could better inform the future development of digital health technologies. Many countries report, however, various technical as well as policy-related challenges in scaling up adoption of PROs. This is a significant missed opportunity to inform improvements in health systems performance (OECD, Forthcoming[5]).

Other secondary uses of data, such as the regular linking of datasets for research or the monitoring of long-term effects of selected therapies is even less prevalent. In recent years, in all countries as well as within transnational EU-funded initiatives, significant investments have been made in improving the use of data for these purposes, especially in cancer care (OECD, 2019[3]).

The COVID-19 pandemic, has shown again how important linked data is for monitoring and performance improvement. It also has served to show that given enough motivation – i.e. with obvious necessity and existing opportunity –, resources and efforts are pooled and quick progress is made (Box 1.3).

Box 1.3. The COVID-19 crisis – leveraging data and interoperability to improve surveillance, monitoring, and care

Global health emergencies bring strongly to light the importance of comprehensive, comparable, and up-to-date data within and between countries. If deployed well, digital technologies and interconnection provide access to such data and can help to better detect, monitor, comprehend, respond to, and recover from crises such as the COVID-19 pandemics.

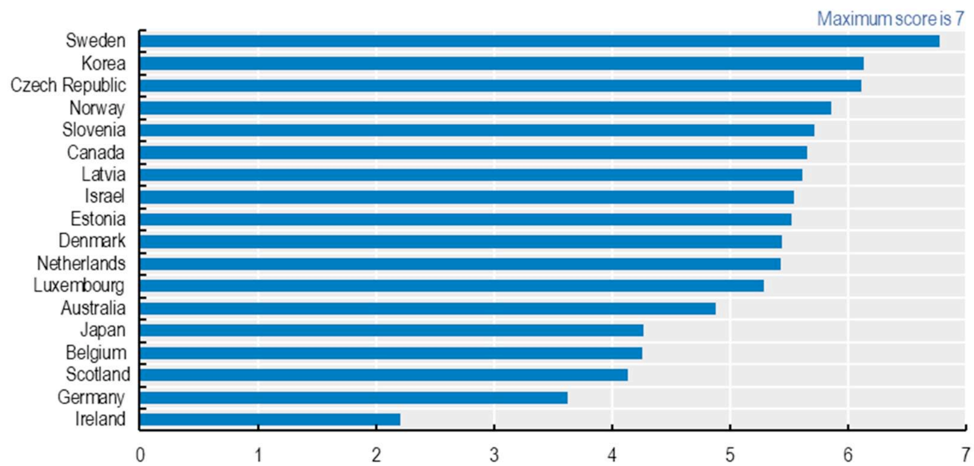
Countries with standardised national EHRs can, for example, follow up much more comprehensively on the full spectrum of health outcomes, in addition to the incidence and death rates. However, as discussed above, most countries do not have the technical and operational readiness to generate such information from EHRs (OECD, 2020[9]).

Countries with low interconnection between data systems had to embark on *ad-hoc* efforts to quickly gather data on, for example, treatments and outcomes of patients with COVID-19 to help providers in learning about and adopting best practices. In Germany, for example, an initiative to create a unified record of all COVID-19 patients treated across all German university hospitals has been launched within a matter of days, with quick deployment of funding for this project by the Ministry of Research (Federal Ministry of Education and Research, 2020[10]).

Furthermore, real-time administrative data on, for example, hospital-bed capacity at a regional or national level is of high value. Only a few countries, such as Denmark and Sweden, have systems allowing for monitoring hospital-bed capacity, including in intensive care units (ICUs), with acceptable time lag. These systems allow for more precise responses to capacity constraints in situations such as a pandemia. In other countries, Germany, for example, in the face of COVID-19 outbreak, the Robert Koch Institute (RKI), the German Hospital Association (DKG), and the German Association of Intensive and Emergency Care (DIVI) together have set up within days a new website where each hospital can update daily their available capacity for intensive care with respiratory support (DIVI, 2020[11]). Similarly, a centralised system to which hospitals provide daily data on bed occupancy, both in critical and conventional care, has been stablished rapidly in Spain.

In sum, there persists high variability across the EU and OECD countries in the availability, quality, linkage, and use of the key national health datasets. However, with the onset of the current COVID-19 pandemic and the ensuing reflexion on the potential for future communicable-diseases pandemics, there is a growing recognition that the capacities of health systems to deliver services in a crisis is based in part on digitalisation, and thus, some of the barriers to digital transformation are being removed. Figure 1.4 presents national scores reflecting the overall progress on data practices for 18 countries that made the requisite information available (before the onset of the COVID-19 pandemic). Sweden reports near-universal availability, quality, linkage, and use of national datasets (for primary and secondary purposes), while Ireland and Germany show the largest room for improvement (OECD, Forthcoming[5]).

Figure 1.4. Progress in datasets availability, quality, linkage, and use is mixed across the EU and OECD countries



Note: The score accounts for seven key elements: **(i)** the number of the national datasets available (out of 13 key datasets); **(ii)** the proportion of datasets with population coverage of at least 80%; **(iii)** the proportion of datasets where data is extracted automatically (and in real time) from electronic clinical or administrative records; **(iv)** the proportion of datasets that can be linked through a unique patient/person identification number; **(v)** the proportion of the datasets where standard codes are used for clinical terminology; **(vi)** the proportion of the datasets used to regularly report on health care quality or health system performance (published indicators); **(vii)** the proportion of the datasets regularly linked for research, statistics, and/or monitoring.
Source: OECD Survey of Health Data Use and Governance, 2020; (OECD, Forthcoming[5]).

1.2. Reconciling the risks and benefits of data sharing is challenging but feasible

The health sector has unique characteristics and health data are very privacy-sensitive, which contributes to the challenges in broadening data sharing and use. Broader data sharing and use increases the risk of data loss or misuse that can bring personal, social, and financial harm to individuals and can diminish public trust in health systems and governments, which might prove hard to remedy once it has happened.

Nevertheless, protecting data and putting them to work are not mutually exclusive – both can be achieved with strong data governance frameworks. Substantial progress has been made in reconciling these risks and benefits, especially through laws and guidelines at the EU level, such as the General Data Protection Regulation (GDPR) that came into force in 2018. The EU is now the most advanced region to promote the sharing of health data across national borders while continuing to protect privacy. Countries are further supported through guidelines being developed by the European Data Protection Board (EDPB), which includes representatives from the data protection authorities of each member state. The progress at the national level varies, however, with many countries still adapting their systems to respond to the GDPR (OECD, 2019[2]).

Moreover, the OECD Council Recommendation on Health Data Governance (OECD, 2019[12]), provides a mechanism for further harmonisation of the national health data policy and governance frameworks to create a global information ecosystem that can securely extract knowledge from an even larger pool of health data.

The governance of data sharing and privacy protection, however, is s fast-moving field, where new questions arise continuously with the development of new data-driven digital innovations. This requires deeper, ongoing discussion and the development of dedicated, clearly articulated ethical frameworks and charters. The European data strategy newly announced by the European Commission in February 2020 is a right step in this direction (Box 1.4).

Box 1.4. Europe as a leader in the data economy

The objective of the **European data strategy** announced on 19 February 2020 is to make sure the European Union becomes a role model and leader for an economy and society empowered by data. For this, it aims at setting up a true **European data space**, a single market for data, to unlock unused data, allowing it to flow freely within the EU and across sectors for the benefit of businesses, researchers, and public administrations. Citizens, businesses, and organisations should be empowered to make better decisions based on insights gleaned from non-personal data.

To achieve this, the European Commission will first propose how to establish a better and future-proof regulatory framework regarding data governance, access, and reuse. This entails creating incentives for data sharing, establishing practical, fair, and clear rules on data access and use, which comply with the European regulations in the fields such as personal data protection and consumer protection. It also means to make public-sector data more widely available by opening up high-value datasets and allowing their reuse. The Commission will also launch sectoral actions in connection to, for instance, the European Green Deal or health.

Source: Communication on Europe's digital future https://ec.europa.eu/info/sites/info/files/communication-shaping-europes-digital-future-feb2020_en_4.pdf; Communication on European strategy for data: https://ec.europa.eu/info/sites/info/files/communication-european-strategy-data-19feb2020_en.pdf

1.3. The future lies in flexible component-based digital architectures

The adoption of digital data systems within the health sector frequently continues in an environment shaped by paper-record thinking, which limits success. Current EHRs, for example, do not always permit applications to communicate, or search for and synthetize information (see also 1.3. in Chapter 2). Moreover, with the proliferation of data-collecting mobile devices, connectivity suffers even within single organisations as the use of common standards that allow for interfacing between the electronic records systems and the devices is not adequately widespread (OECD, 2019[13]).

Various new categories of digital technologies are certainly being deployed, but might merely co-exist within a health system, without being interconnected in any way and thus put into joint use. Such a situation not only prevents technologies from realising their potential but also contributes to an impression of a fragmented digital landscape, which can lead to a 'disillusionment' with the technologies among their end-users, i.e. the health workers and patients.

The increasing pace of technological development further increases the need for interoperability and flexibility within the health data systems. The future lies in the development of flexible component-based architectures, which function as a unified 'ecosystem', i.e. an open and supplier-independent common network consisting of interdependent services and components linked by common standards and principles. Countries such as Estonia, Denmark, or Sweden have made noteworthy progress in this direction. In the EU, success will depend on the adoption of common standards and generation of core data by all international parties.

This naturally requires investment, but first and foremost it necessitates a long-term strategic vision on how the different emerging strands of digital health technologies should be organised together to work collectively in support of health policy goals. Such a strategic vision needs to include a commitment to create supportive legal frameworks and to continuously modernise the digital data security standards.

2. Telehealth, mHealth, and assisted living – progress in bringing health care to the patient

During the last decade, telehealth has rapidly evolved far beyond what is traditionally associated with this term, i.e. the real-time consultations between geographically separated patients and physicians. Advanced telehealth models not only help to provide care to difficult-to-reach patient groups, who otherwise would not access any care, but can generally support the design of more effective and efficient care models and help to move away from reactive towards proactive approaches to preserving health. During the COVID-19 pandemic, the ability of health systems to enable or increase access to tele-consultations has been of critical importance. Where existing, more advanced telehealth models allowed also for continuing provision of health services to, for example, patients with chronic conditions.

At present, telehealth involves a combination of various digital technologies, including mHealth and assisted living, which aim at facilitating, for example, the relocation of services from physician offices and hospitals to patients' homes, irrespective of whether a patient lives in a remote area or not. Telehealth can also include 'virtual health assistants', which are certified online chatbots that can provide basic health check-ups by enquiring about symptoms and answers to a range of health-related questions at any time.

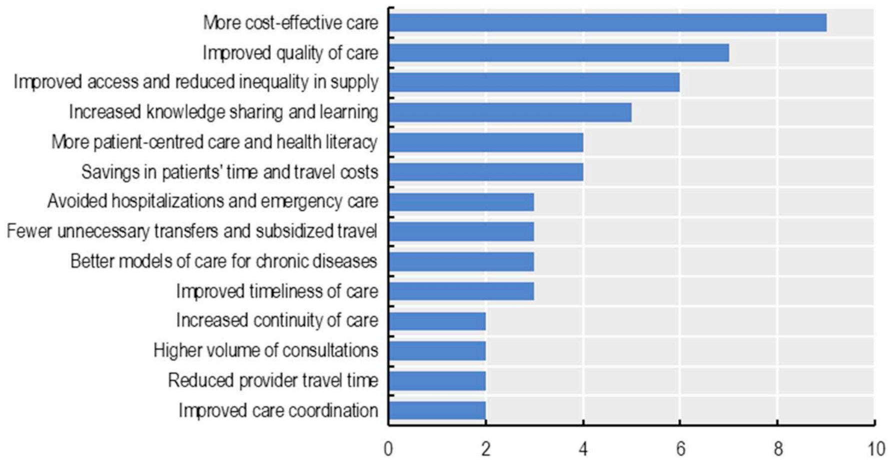
2.1 Despite growing evidence of benefits the use of telehealth remains limited

A growing body of evidence suggests that given the right approach and implementation process, telehealth can be safe and cost-effective, and in some cases provide better outcomes than conventional face-to-face care. This in turn can liberate capacity and enable greater access (Figure 1.5) (Oliveira Hashiguchi, 2020[14]).

The gains are frequently due to the potential of telehealth, incorporating mHealth solutions, to move towards more proactive approaches to preserving health. Home telemonitoring of patients with chronic conditions, for instance, allows to better anticipate deterioration by interacting with the patient earlier and more effectively in the course of treatment and not only when the patient is physically present at a site. Telehealth can also enable patients to take an active part in their treatment and care, which improves self-management skills and encourages a more effective co-production of health. Even simple digital health apps that, for example, allow patients to track their therapy and provide real-time information back to the provider for intervention and/or targeted follow-up, can be effective for prevention purposes and in improving patients' adherence to pharmaceutical and other treatments (Khan and Socha-Dietrich, 2018[15]).

Figure 1.5. Telehealth can lead to gains in effectiveness, efficiency, and equity, if used adequately

Impacts of telehealth highlighted by experts, by number of reporting countries



Source: 2019 OECD Survey of experts' opinions on telehealth; (Oliveira Hashiguchi, 2020[14])

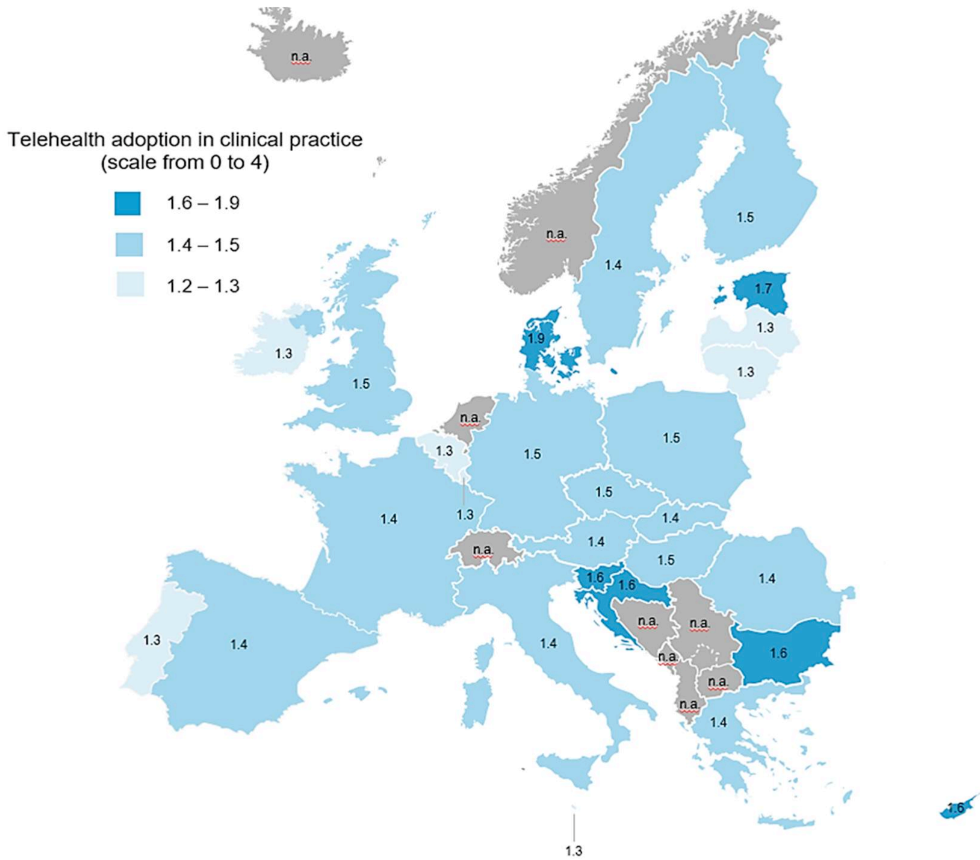
Most telehealth solutions are devised for primary care and there has been progress in their adoption in all EU countries, but the overall use remains low. GPs in Denmark and Estonia reported the highest adoption of telehealth (Figure 1.6) (European Commission, 2018[7]). Denmark is also leading in the adoption of telehealth for services traditionally provided in hospitals, as part of the activities with the strategic aim of improving quality of care, increasing patients' self-care skills, and reducing the need for hospital care. In 2020, based on successful pilot projects, Denmark launched two national telehealth models – for patients living with chronic obstructive pulmonary disease (COPD) and women with pregnancy complications, respectively (Box 1.5). Another telehealth model, allowing home- or nursing home-based in place of hospital-based care for chronic wound patients, has existed in Denmark since 2016 (see Box 2.4 in Chapter 2) (Healthcare Denmark, 2018[16]; Digital Health Strategy - Denmark, 2018[17]).

In the remaining majority of the countries, telehealth programmes remain small-scale, local, or pilot projects, involving between a few hundred to at most a few thousand patients (Oliveira Hashiguchi, 2020[14]). The most common realisation of telehealth remains the video consultations. As for telemonitoring, the most often piloted services target patients living with chronic conditions, such as chronic heart disease, COPD, or diabetes. Some countries run local telemonitoring projects in mental health (Denmark, Ireland), chemotherapy (Denmark, Norway), palliative care (Lithuania), or cancer screening (Poland). Virtual health assistants are also increasingly used – for example in Denmark, Portugal, or Sweden (Oliveira Hashiguchi, 2020[14]; Digital Health Strategy - Denmark, 2018[17]). There is, however, need for more evidence to assess their impact.

The use of standalone digital health apps remains mostly at the discretion of the patients, with few countries – Denmark, Estonia, Germany, and England – investing in the evaluation of such apps and permitting the prescription of and reimbursement for those with proven value. Denmark has also an established tradition of public-private co-creation of apps – as opposed to a development without the input of providers and patients – thus to ensure that these tools are informed by the actual challenges the latter are facing (Digital Health Strategy - Denmark, 2018[17]).

Figure 1.6. Telehealth adoption is still limited across the EU

The score reflects the share of GPs who indicated the following state of telehealth use in their practice:
0 = not aware; **1** = do not have it; **2** = have it and do not use it; **3** = use it occasionally; **4** = use it routinely.



Note: The score does not reflect rapid progress achieved in a number of countries during the current COVID-19 pandemic (see also Box 1.6).
Source: (European Commission, 2018[4])

Box 1.5. Telehealth in Denmark – introducing new patient-centred models of care

In Denmark, telehealth services are relatively advanced owing to clear regulations and guidance, sustained financing, and appropriate reimbursement.

Telemonitoring for COPD patients – meeting the challenge of growing burden of chronic conditions

COPD can reduce the patient's ability to engage in everyday activities, leading to a reduced quality of life and even social isolation. Here, telehealth aims at tracking the development of the disease more closely and establishing early interventions. Twice a week, the patient tests blood pressure, pulse rate, oxygen saturation, and body weight with equipment connected to a tablet and a user-friendly app. The patient also answers health-related questions about breathing difficulties and coughing. The results are transmitted through mobile broadband to a designated health professional, who may take action at any given time if necessary.

The system can also be used by a physiotherapist to follow-up on a rehabilitation plan, if issued upon a discharge from a hospital. In addition, through the use of sensors, patients can check that they are doing the rehabilitation exercises correctly. Patients are referred to the telemonitoring by a GP and are introduced to the routine during a visit of a home-care nurse. Nearly all enrolled patients found the system “easy” or “very easy” to use.

Home monitoring for women with pregnancy complications – better, closer, and more personal care

For women experience complications during pregnancy, being hospitalised is still common. While home monitoring solutions for measuring physical parameters and detecting early warning signs have been available for years, the monitoring of biochemical parameters has only been possible at hospitals. Since 2020, women in Denmark are offered home monitoring as an alternative to a prolonged hospital stay. The service is built on a user-friendly open-source platform, developed in collaboration between patients and professionals with a participatory design approach. The underlying methods have been developed in close cooperation between public healthcare providers, research institutions, and private telehealth enterprises.

The clinical trial showed that transferring pregnant women from hospitalisation to home monitoring has led to substantial benefits for patients and hospital staff, without lowering satisfaction levels or the quality of care. The number of outpatient visits has been reduced, staff spent 75% less time on patient monitoring, and the number of inpatient days for women with pregnancy complications has been reduced by nearly a half.

Source: (Healthcare Denmark, 2018[16]; Danish Government, Local Government Denmark, and Danish Regions, 2016[18])

The main barrier to a wider adoption is not only the shortage of sustained funding but also the lack of any strategic perspective – telehealth is rarely perceived as a catalyst for new care models but rather as add-on service. There are also delays in adapting legislative and financial frameworks for the digital era. While telehealth is generally allowed in most countries, there can be restrictions with regard to the type of services that can be delivered remotely or requirements for an initial and/or a follow-up face-to-face appointment between the physician and a patient. Many countries reimburse a limited number of services, apply a reduced rate of reimbursement as compared to face-to-face consultations, or do not reimburse it at all. Unclear or outdated regulations on privacy and data security form additional barriers. Moreover, gaps in digital skills make health workers hesitant to adopt telehealth (Oliveira Hashiguchi, 2020[14]).

As mentioned earlier, the COVID-19 pandemic, serves to illustrate also the benefits of telehealth, and once again that given the right incentive various barriers to progress can be removed quickly (Box 1.6).

Box 1.6. Telehealth and mHealth solutions for managing the COVID-19 outbreak

In many countries, the COVID-19 pandemic provided motivation for the governments and public organisations to adapt or develop telehealth and mHealth initiatives for managing the crisis.

Telehealth allows people to consult physicians remotely – avoiding potentially infecting others, including the health workers, or even themselves if they do not have any infection. In Denmark, for example, teleconsultations for patients with flu symptoms have been a long-established service (with phone consultations in the pre-digital era). This has supported better management of the COVID-19 outbreak in Denmark (owing also to the availability of the electronic-sick-leave and e-prescription systems).

France, England, Japan, and the United States have relaxed regulatory barriers for teleconsultations in the wake of COVID-19 outbreak. In France, the restrictions on the reimbursement and the requirement of a prior face-to-face visit (once in the preceding year) have been lifted, so that patients can consult with any doctor that uses telemedicine (OECD, 2020[9]). These changes increased the monthly number of teleconsultations from around 40 000 to 600 000 (comparing February and March 2020) (Le Monde, 2020[19]). While the magnitude of demand is surely due to the outbreak of COVID-19, it did arise and could not possibly have been served without the use of telehealth.

In early March 2020, the Polish Ministry of Digital Affairs released a ‘Home Quarantine’ app that allows for basic health assessment and direct reporting of risk. The app also aids with organising the supply of the most-needed items of daily-use (Polish Government, 2020[20]). Similarly, the Estonian Health Board launched an app ‘Coronatest’ with a questionnaire helping to self-assess the risk of being infected and providing tailored recommendations. The anonymised answers have been used in real-time to assess and predict the spread of the disease in Estonia (Estonian Health Board, 2020[21]).

By July 2020, most of the EU Member States had decided to launch mobile apps for privacy-preserving contact tracing and warning to complement manual contact tracing of the spread of COVID-19. The apps are installed voluntarily by citizens and do not allow for tracking people’s locations. These apps alert people who have been in proximity to an infected person for a certain duration, so that they can take the necessary actions like, for example, self-isolation and getting tested. This way, infection transmission can be interrupted rapidly. Moreover, the Member States, with the support of the Commission, have agreed on a set of technical specifications to ensure a safe exchange of information between national contact tracing apps based on a decentralised architecture. Once the technical solution is deployed, such national apps will work seamlessly when users travel to another EU country that also follows the decentralised approach.

2.2 Assisted-living technologies can aid long-term care workers

With an aged population and an increasing number of single-person households, the demand for long-term care (LTC) services is expected to increase. With continued pressure on public finances, policies that can improve LTC-worker productivity may make it easier to meet these needs.

Assisted-living technologies combining digital tools and solutions – such as health apps and other software, sensors, mobile devices, or robots – could be an effective and efficient way to support LTC workers, ensuring that the same number of professionals are able to deliver more and better care. Moreover, most of the care at home is carried out by informal carers, such as relatives. Also for them, these technologies could be an effective and efficient way to ease the demands their role entails.

Many LTC providers already use or are looking for ways to implement simple technologies such as alarm systems, fall sensors, and GPS tracking of the movement of elderly citizens in residential facilities or at home. Mobile devices with health apps can also support remote monitoring of the elderly and may reduce time spent by workers in promoting patients' self-care skills. Other devices, such as medication robots can improve adherence to therapies. The degree of penetration of these devices varies considerably across and within countries, with the digital tools and solutions being more prevalent in private nursing homes and home care services or in those receiving dedicated public funding (OECD, 2020[22]).

There is growing evidence that assisted-living technologies can improve the independence of older people at home, increase the quality of life for residents of nursing homes, and enhance the LTC workers productivity, but more systematic evaluation and assessment are needed. More complex technological devices – such as companionship robots or self-sufficient smart homes – are showing positive results in labs and are slowly making their way into pilot projects in Japan and a few EU countries (OECD, 2020[22]).

Box 1.7. Assisted-living technologies are gradually deployed in long-term residential and home-based care

Apps and web-based solutions allowing relatives and health workers to check on elderly and to keep track of, for instance, their prescriptions, scheduled appointments, or visit by home-care staff. These solutions might also allow the carers to enter patients' homes virtually. Initial evidence from Canada, Denmark, and Sweden indicates that these solutions can free up time by, for example, limiting the number of necessary and unscheduled phone calls or home visits.

Personal alarms are used in a number of countries and allow the elderly to contact care personnel in emergency situations with a single click. Owing to that, patients feel safer at home and are more motivated to perform their daily tasks, which in turn helps them to maintain their mobility.

Pill robots, especially those that can be used with all types of packed and pre-measured medication, appear to be effective in supporting not only medication adherence, but also in saving time of home-care personnel, according to a pilot project in Denmark. The robots ensure the correct dosage and notify both the patients and care workers in case the medication was forgotten, and can be integrated with primary-care or medication records, such that when a physician changes the prescription, the robot is updated in real time.

Digital incontinence solutions, in trials in a number of countries, have shown to increase the quality of care and life for nursing-home residents (due to increased quality of sleep, for example) and to significantly reduce time spend by LTC workers on providing personal hygiene care.

Rehabilitation robots include advanced rehabilitation equipment that helps patients train independently. The robots not only ensure that the exercises are done correctly but also measure and displaying continued progress. The latter function shows to have remarkable impact on the motivation to exercise and significantly speeds up recovery, according to a number of trials across Europe.

Assistive social robots are offered by a number of Japanese producers, with robot Pepper being one of the most know examples. Pepper was initially intended as a companion robot, but is now being tested in hospitals or nursing homes as an assistant collecting and guiding the patients around the facilities to their appointments and other daily activities (e.g. in Belgium and England).

Source: (OECD, 2020[22]; Healthcare Denmark, 2019[23]; Khan and Socha-Dietrich, 2018[15])

3. Artificial Intelligence and data-driven decision support – new potential, new challenges

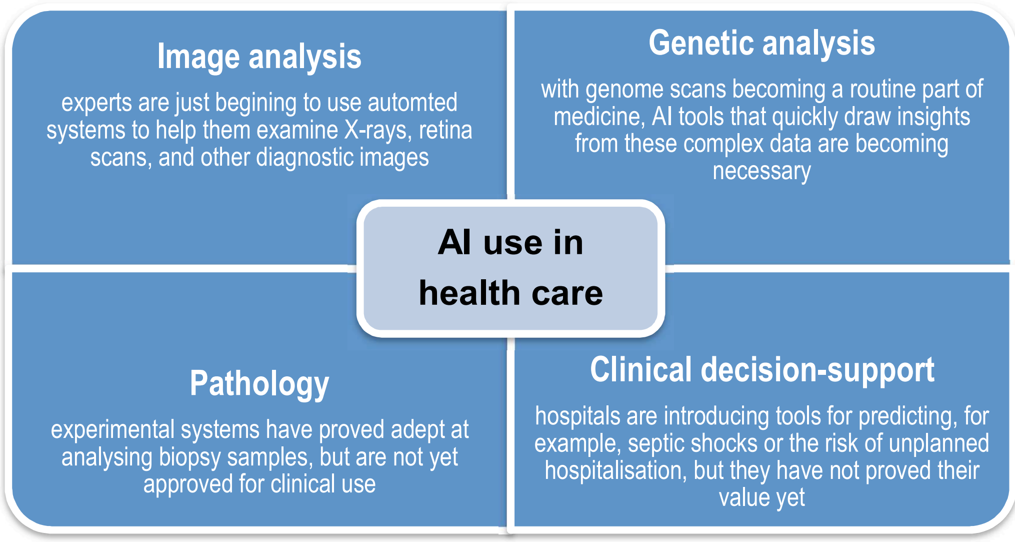
Data-driven automation, prediction, and decision support draw from fields like statistics, linguistics, and computer science, and use techniques such as rules-based systems, regression, predictive analytics, and AI. The latter, especially the recent advances in deep learning, has attracted much attention with regard to its potential for transforming health care and health systems in general.

The potential of AI in health is indeed profound, given the growing volume of electronic data as well as the inherent complexity of the sector, its reliance on multi-layered information to solve problems, and the variability of how diseases interact with individuals and populations. AI can identify unknown patterns or irregularities in data thus helping to improve the accuracy of administrative or clinical decision making, better allocate resources, anticipate risks, or enhance biomedical research and drug discovery, among many other things. AI has also been tested in public health surveillance, for example, in predicting the spread of communicable diseases based on a combination of data from various sources (OECD, 2019[24]).

The use of AI is emerging in some areas of health care (Figure 1.7), but most applications are still in the research and development stage. A recent review of dozens of studies claiming an AI performs better than radiologists in diagnostic image analysis, finds that only a handful were tested in populations that were different from the population used to develop the algorithms (Reardon, 2019[25]). The majority of AI applications in health require large amounts of training data to make predictions. Because these methods are narrowly focussed on a specific task and trained using a specific set of data, these algorithms may not work well when used with data that is even slightly different from the training data. Other examples from image recognition show that changing a single pixel in an image – which is completely irrelevant for the human observer – can change an algorithm's output drastically; or images essentially showing noise are assigned a category at high confidence levels. It is still not understood why AI had some astounding successes in image recognition or why it fails spectacularly when facing setting modifications that are irrelevant for humans (OECD, 2019[26]; OECD, forthcoming[27]).

Generally, computing power and flexible (especially in the sense of unbiased or agnostic) algorithms can be harnessed to find correlations in vast and diverse datasets that a human operator would not have imagined testing for. Still, no matter how sophisticated any statistical analysis might be, it will suffer from the ailments like under- and overfitting, multi collinearities, and it still can only identify a correlation. Hence, the role of the computer analysis is to propose connections that remain to be scrutinised.

Figure 1.7. Emerging use of AI in health care



Source: (IEEE, 2019[28])

Taking into account the above characteristics of data-driven prediction and decision support systems as well as the characteristics of the jobs performed by health workers, to date there is no evidence to suggest that AI will replace humans in health care. Humans and machines are rather going to complement each other. This is not only due to difficulties in automatising tasks such as caring for and assisting patients, but also due to the fact that humans and machines learn how to do things in very different ways (Box 1.8) (OECD, 2019[26]). The latter was once again illustrated by challenges posed by the COVID-19 outbreak: Already at the onset of the crisis, radiologists quickly learned to recognise the typical signs of severe SARS-CoV-2 disease in the CT scans of the lungs (Drosten, 2020[29]). For training an AI system, it might take years to collect enough images and to adequately prepare and label training data, so it could start learning how to detect COVID-19 not to mention diagnosing it.

There is, nevertheless, plenty to suggest that data-driven prediction and decision support will fundamentally augment human tasks and responsibilities in health care. This will require a number of changes, first and foremost in the education and professional training of health workers, who will need new digital skills (see also Chapter 2) (OECD, 2019[26]).

Moreover, going forward, health policy makers should beware the hype and ensure that AI addresses real health-sector challenges, instead of being developed first and then searching for problems that it could solve. In decisions about public investment in AI, it is important to recognise that the field has been researched and discussed for more than 70 years now (Berryhill, 2019[30]). In the face of insufficiently far-sighted funding schemes as well as other market forces, parts of the AI community repeatedly succumbed to the temptation to overpromise results in their struggle for limited resources, which also made this parts gain above average visibility. Over the decades, this led to several so-called ‘AI winters’, where disappointment about unkept promises – not an absence of any progress – resulted in repeated severe funding cuts for AI, or sectors of it, given that AI is an extremely diverse field.

Taken as a whole, AI breakthroughs are known to have returned decades of investment. As is the case with research, however, when exactly a particularly hard problem will be solved is particularly hard to predict. One of the most remarkable examples is the DART logistics scheduling application developed by the United States DARPA (Defence Advanced Research Projects Agency), which paid back all of DARPA’s 30 years of investment in AI in a matter of a few months (Reese Hedberg, 2002[31]). Given that this most remarkable breakthrough of AI took place in the field of logistics and given the logistic challenges posed by the ongoing pandemia, suggests loudly the use of AI logistic solutions in planning the deployment of the limited resources needed to fight its consequences. This, however, presupposes that the whereabouts, quantities, and characteristics of the available resources – like beds, ventilators, ambulances, medical personnel – but also of patients with (previously existing) comorbidities are known, which brings us back to the need of interoperable record keeping in health care.

In parallel, there is a need to recognise and address the risks of unintended and negative consequences associated with AI. AI relies critically on the availability of data at scale and linking of different datasets. This brings up the question of how to effectively increase data availability without compromising privacy and data security, as discussed above in 1.2. Moreover, the performance of AI will depend on the quality of the data it uses. If the data is biased, due to, for example, the inherent biases in human thinking or social norms, the broader use of AI creates the risk of entrenching such biases instead of removing them. AI, deep learning in particular, might also lack transparency, without which identifying, for example, when human rights have been violated or seeking remedy and determining accountability will be difficult (see also Chapter 2).

Box 1.8. In health care, humans and machines learn and work differently and could complement each other

Evidence teaches that, generally, computers need well defined and predictable – i.e. ‘kind’ – learning environments to succeed in a task, while people can learn and succeed in both ‘kind’ as well as in ‘wicked’ environments characterised by variation and uncertainty. In a ‘kind’ learning environment accurate inference is made possible by a close and accurate feedback on predictions (or actions taken) as well as small or no variation between the dataset used for learning (training) and the one to be analysed. If the learning environment is not ‘kind’ enough, successful training of a computer requires much larger training datasets as compared to humans, but might become altogether impossible in the presence of biases (Hogarth, Lejarraga and Soyer, 2015[32]).

Health care is by default teeming with variability and uncertainty as well as, oftentimes, unavoidable biases and as such represents a ‘wicked’ learning environment; potentially with the exception of some clearly delineated data-rich subsectors. As a consequence, relying alone on AI outputs in health care is not an option, at least not for some time to come. Where, however, computers can be taught to reliably perform a task, they excel over humans by the sheer volume of these tasks they can perform per unit of time and over time without tiring (EXPH, 2019[33]). This suggests to join the advantages of computers and humans in tackling tasks in health care. A captivating example outside the health-sector context for the achievement potential of human-computer tandems is Advanced Chess, where experienced but unranked human chess players in cooperation with strong PCs can outperform grand masters and supercomputers (Thompson, 2014[34]).

The need for large training datasets bars computers from permeating areas with sparse data of which health sciences abound. For new diseases (like COVID-19), new cancer therapies, or relatively rare patients like those in the highest age groups or rare diseases, large and clean enough datasets will not exist for years to come or might never be available. Watson for Oncology, for example, even if it finally succeeds in aiding oncologist in their decision-making, will not be able to take into account innovative therapies as fast as the oncologist do. This is because the deep-learning algorithms rely on statistics and will not consider a new fast-tracked innovative drug that rapidly throws over existing clinical guidelines (IEEE, 2019[28]).

Even where large datasets could be available in principle, they must first be created, analysed, and labelled by diagnosis by highly trained specialists. Humans, in comparison, can learn how to interpret less homogeneous imagery based on theory, association, and context – combining concepts from different scientific fields (e.g., anatomy, physiology, or medical physics) – even on small samples.

Moreover, no matter how advanced the system, health professionals and researches will need to train the computer initially as well as repeatedly if there occur changes in either data acquisition – for example, when improved image diagnostic equipment becomes available – or reference standards – for example, due to progress in medical research.

Source: (OECD, 2019[26])

The work on how to maximise the potential of AI while addressing these risks is in progress across Europe and other OECD countries. The recent strategy for trustworthy AI proposed by the European Commission (Box 1.9) further delineates actions European countries can take to address the risks of unintended and negative consequences associated with AI. At the global level, the OECD Recommendations on Artificial Intelligence (OECD, 2019[35]), the first international standards agreed by governments for the responsible stewardship of trustworthy AI, can also guide countries in establishing the appropriate legal frameworks.

Box 1.9. Europe as a leader in trustworthy Artificial Intelligence – The European Commission's strategy for AI

As AI systems can be complex and bear significant risks in certain contexts, building trust is essential. For high-risk cases, such as in health, AI systems should be transparent, traceable, and guarantee human oversight.

In its White Paper presented in February 2020, the European Commission envisages a framework for trustworthy Artificial Intelligence, based on excellence and trust. In partnership with the private and the public sector, the EC's aim is to mobilise resources and to create the right incentives to accelerate the deployment of AI. This includes working with Member States and the research community, to define clear rules needed to address high-risk AI systems without putting too much burden on less risky ones, as well as to attract and keep talent for AI development and use in public services.

Source: Communication on Europe's digital future: https://ec.europa.eu/info/sites/info/files/communication-shaping-europes-digital-future-feb2020_en_4.pdf ; White Paper on Artificial Intelligence: https://ec.europa.eu/info/sites/info/files/commission-white-paper-artificial-intelligence-feb2020_en.pdf

4. Costs of inaction

As the discussion above illustrates, digital transformation is urgently needed and long overdue at a time of increasing pressure on health systems. Prolonged inaction will come at a cost of missed opportunities to build more effective, efficient, people-centred, and resilient health systems.

The failure to leverage digital technologies to deliver right information and knowledge to the right people at the right time is a significant missed opportunity to improve the quality of care. For instance, 10% of patients are unnecessarily harmed during care, most frequently due to information and knowledge not reaching the right person at the right time. The health burden of this shortcoming in OECD countries is on a par with that of diseases such as multiple sclerosis and some cancers. The direct financial impact is as high as 15% of hospital expenditure, and the broader economic loss is estimated to be in the trillions of dollars (Slawomirski, Auraaen and Klazinga, 2017[36]). Interoperable electronic information platforms, with access to the electronic records by all actors involved in a patient's care (including patients themselves) are key structural components of a high-quality health system (Auraaen, Slawomirski and Klazinga, 2018[4]).

Better information and knowledge exchange can make health systems also more efficient. Care can be better coordinated by different providers and integrated with other services, with better results as well as less duplication and the ensuing waste of resources (OECD, 2017[37]). This is especially important considering the growing number of people living with multiple chronic conditions, currently estimated to represent at least 20% to 30% of the adult population across OECD countries. Services delivered to these individuals can be inefficient and ineffective in a system, where information is fragmented across sectors, providers, and disease groupings (OECD, 2019[2]).

In general, health systems are plagued by a significant waste of resources such as the unnecessary duplication of diagnostic tests or services, avoidable hospitalisations, inappropriate care, and other inefficiencies within clinical, operational, and administrative activities. OECD estimates that around a fifth of health care expenditure across the OECD countries (around USD 1.3 trillion annually) is wasteful, i.e. it is not used to generate better health, and sometimes even harms health (OECD, 2017[37]).

Digital transformation offers ways to reduce this waste, improving health outcome and freeing up resources towards more productive ends. Effective data linkage and analysis, for instance, sheds light on what is really going on in a complex health system, and is a critical step to assess performance, identify problems such as unwarranted variation in service delivery, and enable smarter resource allocation. Digital tools and solutions can make services more accessible, appropriate, and responsive, by enabling more proactive, rather than reactive, approaches to preserving health, especially through supporting greater patient engagement in the care process and the development of the patients' self-care skills. Data and digitally-driven innovations can also help address unmet health needs by a more accurate identification of these needs, which then informs the design of more tailored and people-centred services. All this would not only help to cut wasteful spending but, more importantly, result in healthier and more productive populations (OECD, 2019[2]).

While the examples of the direct economic and health benefits discussed above and in the other sections of this chapter are not exhaustive, the most recent estimates by the OECD suggest that the combined economic benefits of putting data and digital technology to work in the health sector could amount to 8% of the total health expenditure of all OECD countries (OECD, 2019[2])[2]. It is a conservative estimate and, compared to other projections, is not far-fetched. For example, other sources have suggested:

- projected savings generated by leveraging digital technology and data in the health sector to be as high as 17% of the health care expenditure (Kayyali and Van Kuiken, 2013[38]);
- estimates of the potential for achieving efficiencies amounting to GBP 13 billion a year in the National Health Service of the United Kingdom owing to greater adoption of digital technologies (OECD, 2017[39]).
    - NHS data alone have been valued at GBP 9.6 billion per annum, the value generated principally by the new knowledge and insights that could be unlocked from them (EY,

[2] Based on data for 2018.

2019[40]). This is approximately 5% of health expenditure in the United Kingdom (OECD, 2019[41]).

5. Providing adequate support for health workers

A successful digital transformation in the health sector is not a simple matter of technical change but requires a complex adaptive change in human expertise and skills. Digital technology only provides the tools but cannot transform the health sector on its own and needs to be put to productive use by the health workforce. However, health workers often report not having sufficient opportunities for the up-skilling required to put the technologies to full use. This skill gap needs to be effectively addressed to ensure progress and avoid unnecessary strain on health workers.

While the skills gaps and other health workforce-related barriers to successful digital transformation are discussed in depth in Chapter 2, it is worth considering here that the examples of digital technologies discussed in this Chapter can be deployed in almost any aspect of health care provision, across different service sectors, care settings, and patient groups. This implies that all health workers will be exposed to the various types of digital tools and solutions offering information, automated decision support, and new options for engaging with patients as well as collaborating with other workers across the system.

Whether some categories of digital technologies will be more often used by physicians, nurses, or other formal care providers depends on the particular configuration of health services in a given country, including the scope of practice of different professional groups.[3] It should also be taken into account that care models evolve, with tasks or entire services being shifted between the different categories of health workers (e.g. from physician to nurses, to nursing assistants) as well as between different service sectors (e.g. from hospitals to primary or home-care) (see for example Box 2.4 in Chapter 2). Moreover, certain categories of health workers, such as Advanced Practice Nurses, Physician Assistants, or Nursing Assistants exist only in some of the EU and OECD countries.

Therefore, support for the development of digital skills will need to be provided for all categories of health workers. This implies substantial effort on the part of the educators. However, the fact that digital skills are commonly needed across the different professional groups indicates also that there is a substantial scope for interprofessional collaboration and pooling of expertise, which can ease the development of digital health education content, as discussed in detail in Chapter 3. (Denmark, for example, developed a single common digital competency framework for all – of its nine categories of – non-physician health workers.)

[3] In a number of the Anglosphere countries, for example, nurses provide care in relatively numerous roles and settings, with extensive task-shifting from general practitioners to advanced practice nurses. In Japan, primary care is not recognised as a specialty, hence, telehealth services for patients living with chronic conditions are provided by specialists. Moreover, a number of countries launched reforms expanding the role of pharmacists in the care for patients with chronic conditions or of physiotherapist in home care.

2 Health workforce-related barriers and enablers to digital transformation

KEY MESSAGES

As discussed in Chapter 1, the potential benefits of digital health technologies are abundant, across all care sectors and settings. Hence, **all health workers will be exposed to digital tools**, offering information, automated decision support, and new options for engaging with patients as well as collaborating with other workers across the system.

However, **the presence of the digital tools and solutions is not enough. It is crucial to ensure that the health workers actually use them**.

Whether and when digital technologies become effectively used depends on the

- **health workers trust in the technology** and whether its benefits are perceived to outweigh low-tech (or no-tech) methods;
- **up-skilling of front-line health workers, managers, and other professionals in the health sector** through new education and professional training content, on one hand, and counteracting de-skilling, on the other;
- **timely adaptation of the existing models of work** and the related legal and financial frameworks.

In the labour intensive health sector, a successful digital transformation critically depends on changes in health workforce perceptions of the technologies, their skills[4], as well as the existing models of work and the related legal and financial frameworks. This Chapter discusses the barriers to and enablers of digital transformation related to:

- 1 the trust and perception of digital health technology among health workers;
- 2 the skill-mix among health workers and other health-sector workforce;
- 3 the existing models of work and the related legal and financial frameworks.

[4] Throughout the report, the term ‘skill’ is used to indicate all types and facets of competences needed by workers to perform their jobs. This is done partly for the sake of simplicity but also because, in most of the literature, the terms ‘knowledge’, ‘competencies’, ‘abilities’, ‘skills’, and, to a lesser extent, even ‘education’ are often used interchangeably. Although there might be some conceptual differences between these terms, all of them refer to the interactions between workers and their jobs.

1. Trust in and perceptions of digital health technology vary among health workers

1.1 Low awareness of benefits of and progress in technology might feed negative perceptions

The perception that health workers have about digital technology influence whether and how effectively it is used in the day-to-day practice of health care. There are a number of external as well as individual factors that shape the perceptions (Figure 2.1).

The level of trust in digital health technologies and whether the share of positive perceptions outweighs the share of negative ones, depends largely on the maturity of the digital culture in a given country. A well-developed digital culture is mostly expressed by a wide general offer and use of digital tools and services, especially inside the public services sector, for example, to communicate with the authorities or to obtain various permits, registrations, or certificates through electronic means and automated systems. Countries that are most advanced in the adoption of digital health technologies, such as Estonia, Denmark, or Sweden, rely on digital technologies also in the provision of a whole range of public services.

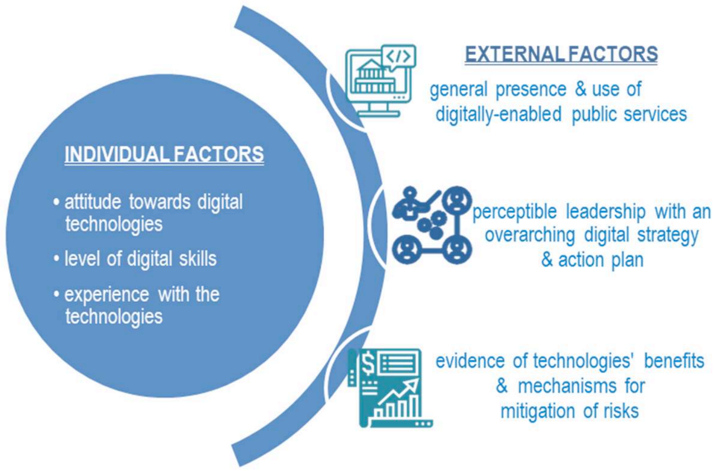
Inside a health sector, a more positive perception depends on how effectively the high-level health-system stakeholders engage with health-care providers and communicate their overall strategy for digital technologies in health. When the strategy and communication are lacking, health workers might find it hard to see how the introduction of various digital tools and services collectively supports the main health system goals, and how it is expected to meet the needs of patients, their families, and the health workers themselves (OECD, 2019[2]) (OECD, 2019[26]).

Even when a digital health strategy and an action plan exists, governments frequently focus on the technology in their communication, while the intersection of health and technology does not quite materialise. In effect, health workers worry that digital is taken for granted to be better than non-digital, and that the assessment of the technologies does not account for the full spectrum of their potential impact.

Moreover, health workers and patients frequently raise concerns with regard to, for example, the security of patient data; if data protection measures are not sufficiently trusted, digital health tools and services are less likely to be used (Li, 2013[42]) (European Commission, 2018[7]). At the same time, health workers and patients usually have limited awareness and knowledge of the actual security measures put in place or the general investment in and the quality of health data infrastructure (OECD, 2019[26]). Hence, the negative perceptions prevail, regardless of whether the security problems actually exist.

In addition, arguments against digital tools arise from the impression that they are too difficult to use, require more time than the low-tech methods, and that it is the patients, who do not want digital solutions. This is often related to the limited awareness of which functionalities the digital health solutions actually offer, which is in turn caused by a haphazard introduction of many technologies that, in particular, fails to account for the time and training health workers need to learn what the technology has to offer.

Figure 2.1. Main factors shaping perceptions of digital health technologies among health workers



1.2. Emerging questions are not always fully addressed

The stakes are decisively higher when digital technology affects health outcomes rather than affecting travel arrangements, the shipping of products, or the selection of a car insurance policy.

While digital innovations require the practice of health care to change, the existing legal and ethical frameworks do not necessarily account for these developments. As a result, health workers face unanswered ethical and legal questions, for example, about their and the computers' roles, how to ensure that digital systems do not crowd out patient-provider shared decision making, or about the technology implications for accountability. Already simple decision-support models – such as those automatically stratifying patients into risk and intervention groups – give rise to questions: How to inform a patient when a risk-prediction model did not recommend the treatment? What is a mechanism for patients and health professionals to dispute the model's recommendation? Whether are how are the situations that can arise due to the use of the model covered in the legal liability regulations? While some of these questions can be resolved by professional organisations within professional ethical codes, other require timely adaptation of legal frameworks.

Digital technologies can, for example, improve people's management of their own health. Health workers express concerns, however, that due to inequalities in digital literacy, not all patients benefit from modern digital solutions. Unless these problems are addressed explicitly, innovations might not reach the most disadvantaged population groups (OECD, 2019[43]; Oliveira Hashiguchi, 2020[14]). While health workers can support patients in using technology, providing they themselves possess digital skills, a successful digital transformation requires additional initiatives dedicated to building digital literacy among patients (OECD, 2019[43]).

With the emergence of more advanced and complex digital technologies – such as AI – questions proliferate. As discussed in Chapter 1, the potential of AI in health is profound, but so is the risk of unintended and negative consequences. Health professional associations and regulatory bodies stress that despite very promising opportunities, AI should be monitored critically for their best uses and added value at all times (Box 2.1) (OECD, 2019[44]).

Box 2.1. Health professional associations underline that AI systems in health care present new challenges compared to previous technological advancements

Health professional associations across the EU and OECD countries voice concerns regarding the following characteristics of AI that distinguish it from previous technological advancements and affect the transparency of and accountability for its use:

- **"Black box" and evolving nature**: Certain types of AI systems, notably neural networks, amount abstract mathematical relationships between variables that are extremely complex and difficult for the humans to understand, including those who program and train the system. The unavailability of an explanation of the outcome makes honouring the Right to Explanation anchored in the European General Data Protection Regulation impossible. Without transparency, also determining accountability is difficult.
- **Algorithms can reflect the biases implicit in their training data**: There is significant concern that machine learning algorithms tend to reflect and repeat the biases implicit in their training data, such as racial biases and stereotyped associations representing long-gone societal values. Without appropriate monitoring, these biases might be reinforced or resurrected through a broader use of AI systems. This is why initiatives for building available pools of training data are of critical importance.
- **Increased tensions in protecting personal data**: For many AI systems, more training data can improve the accuracy of predictions and help reduce the risk of bias from skewed samples. However, the more data collected, the greater the privacy risks to those whose data are collected. This includes not only the risk of little or no awareness of consent on the part of the data subjects, but also the risk of 're-identification' of sensitive data: As different datasets are linked, some algorithms can, for example, infer sensitive information from 'non-sensitive 'data or data "de-identified" can be correlated with other data and matched back to specific individuals.

Given these challenges, health professional associations call for legal frameworks that ensure transparent and secure use of AI along with a mechanism for monitoring the technology throughout its life-time and accountability for the results of AI predictions and the ensuing decisions (CPME - The Standing Committee of European Doctors, 2019[45]; EFN - European Federation of Nurses Associations, 2018[46]; PGEU - Pharmaceutical Group of the European Union, 2019[47]).

1.3 Challenges also result from failure to design for the complexity of health care

Along with the negative perception of digital tools and solutions for the health sector, there are also actual problems, such as the lack of user-friendly design and interoperability.

The electronic records systems, for instance, have not always been fully informed by, and designed with the needs of patients and health workers in mind (OECD, 2019[26]). Indeed, in some countries, electronic patient records were designed to address billing and financial functions at least as much as, if not more, than the clinical needs of patients and clinicians. In other cases, suppliers have not put in the resources to perform adequate testing with actual users (The National Advisory Group on Health Information Technology in England, 2016[48]; Wachter, 2015[49]).

The continuing usability issues include electronic records being difficult to read and cumbersome to use, with difficulties for users in being able to rapidly identify or record essential pieces of information. Current EHRs, for example, do not always permit applications to communicate, or search for and synthetize information. As discussed in Chapter 1, the adoption of digital data systems is frequently shaped by paper-record thinking. For health workers, this often means that reviewing the patients' electronic record to find certain details does not necessarily save time as compared with reviewing paper-based records (European Commission, 2018[7]).

There are also problems with effective error prevention, minimisation of cognitive load (alert fatigue), and effective feedback, such that health workers can be sure they entered all the required data and that other workers can see their entries (Zahabi, Kaber and Swangnetr, 2015[50]; European Commission, 2018[7]). This shortcomings require workarounds that increase time spent on a task, add steps to everyday work routines, or duplicate work effort. They also contribute to the opinion that digital health technologies in general get in the way of work and require more time than the lower-tech methods. Wasted patience and wasted trust are very hard to regain and the loss is extended readily to other and future digital tools and solutions. These usability problems have been associated with new forms of technology-induced errors (Turner, Kushniruk and Nohr, 2017[51]; Brennan, McElligott and Power, 2016[52]).

Unfortunately, despite the considerable volume of research providing knowledge and the wide range of methodological tools and techniques available to guide a user-friendly design process, research continues to highlight evidence of poor usability, technology-induced errors, and other unintended consequences from health information systems, applications, and services (Turner, Kushniruk and Nohr, 2017[51]).

Moreover, connectivity suffers even within single organisations if the use of common standards that allow for interfacing between the growing number of data-collecting systems and devices is not adequately widespread (OECD, 2019[13]). Various new categories of digital technologies might merely co-exist without being interconnected in any way and thus without being put into joint use. Such a situation can contributes to a 'disillusionment' with the technologies among their end-users, i.e. the health workers and patients.

2. The skills necessary for a successful digital transformation are often in short supply

2.1. New digital skills are needed to allow technology to add value

All health workers will be exposed to digital technologies providing them with information, automated decision support, and new options for engaging with patients as well as collaborating with other workers across the system, among other functionalities.

There is, however, growing evidence of digital skills shortages among front-line health professionals (OECD, 2019[26]; OECD, 2018[53]; The Lancet Global Health Commission, 2018[54]). Depending on the concrete study and varying between professional categories, between 30 and 70% of health workers report not to have all the skills they need to use digital technologies and fully engage with digital information (OECD, 2019[26]). Digital technology has already changed the way that health workers practice and, while many of them see the potential that these changes can bring to improving the quality and cost-effectiveness of health care, many are also frustrated (Payne et al., 2015[55]) or are struggling to adapt because they do not know enough about the underlying information science in these new digital tools and systems (Fridsma, 2018[56]).

Moreover, the medical, nursing, and pharmaceutical students associations have made calls for including or enhancing the digital health content in educational programmes of their respective fields. The associations regard the development of digital skills as an investment for the future and a possible sustainability measure for health services, based on surveys of their members (EMSA - European Medical Students Association, 2019[57]; EPSA - European Pharmaceutical Students' Association, 2019[58]; EFN - European Federation of Nurses Associations, 2018[46]).

There are also indications of serious shortages of digital skills among long-term care (LTC) workers. The recent OECD report assessing the state of the long-term care workforce across the EU countries stresses that greater adoption of digital technologies is one of the main components of the strategies to address the shortages of LTC workers and the growing demand for LTC services. This must, however, be coupled with the recognition that LTC workers need up-skilling in digital health technologies as much as other main categories of health workers. In particular, there is an urgent need to improve training of personal care workers and those providing routine personal care who are not qualified or certified as nurses. Their tasks go well beyond help with basic activities, such as washing, lifting out of bed, helping with feeding. They are often involved in monitoring health, participating in the implementation of care plans, and maintaining health records, which are main areas of application for digital technologies (OECD, 2020[22]).

Health workers who believe they lack the requisite skills are less likely to use digital tools and solutions, but digital health content is frequently only included as an elective course in education or professional training programmes and not taught at a high enough level (EU*US eHealth Work Project, 2019[59]; WHO, 2016[6]). Moreover, it is presented as a standalone subject rather than being integrated across subjects, which is not conducive to building a digital culture or the perception of digital technology as an integral component of health care.

There has been an ongoing research effort in the development of digital health competency frameworks to inform the required changes in the education of health workers, both at national and international levels. The largest international project in this field has been the *2016-2018 EU-US eHealth Work Project*, which, among other outputs, produced a competency framework as well as commensurate educational content (EU*US eHealth Work Project, 2019[59]). Box 2.2 summarises the main skill sets identified as essential for an effective deployment of digital technologies in the health sector.

There is a remarkable convergence across health professions and countries in recognising which broad categories of digital skills the future-proof health workforce will need. Indeed, as discussed above all health workers will be exposed to digital technologies. Recognising this, the governments in some countries have supported collaboration among educators within the various professional groups in the joint development of the education and training curricula. In Canada, digital health content has been developed jointly by educators' organisations from medicine, nursing, and pharmacy. Similarly, in Denmark, a unified digital competency framework has been developed for nine different categories of non-physician health workers, such as midwives, nurses, nutritionists, or physiotherapists (for more details see Box 3.3 in Chapter 3).

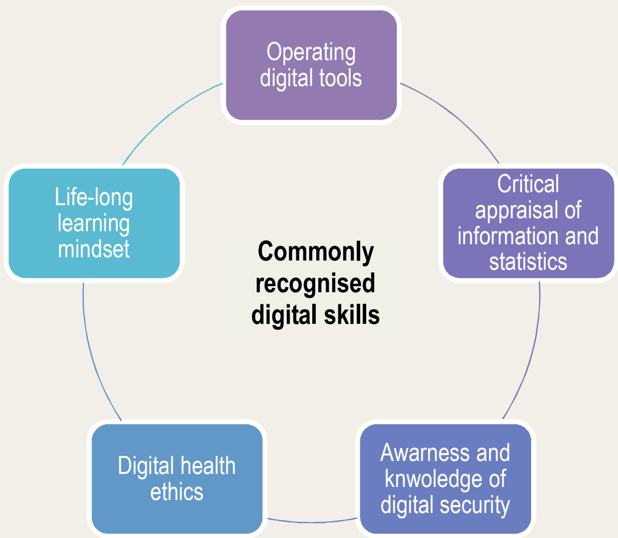
Health workers will not only need to know how to operate digital tools and be aware of digital security procedures, but will also increasingly need strong skills in the critical appraisal of information and statistics. Interpretation of the merits and perils of technology-derived data in the context of probability and their sensitivity and specificity for a given patient are crucial; otherwise, technology, despite its potential, might muddy the health workers' judgment. This includes, communication of the value of Real World Data to health workers and sensitising them on their own impact on the quality of these data. Health workers are not only users of digital technologies but also – implicitly – participate in the development of digital technologies by generating a data basis in routine clinical practice. Health care professionals should, for example, be made aware that the coding of diagnosis and treatment in electronic records is highly relevant as an input factor for data-driven digital tools and solutions.

Equally important is also the development of skills in digital health ethics that equip health workers with critical orientation knowledge and empower them to responsibly use digital technologies in care or research, by helping them understand and weigh both the implications of using and the implications of refraining from the use of the technologies.

Box 2.2. Main categories of digital skills commonly recognised as crucial for future-proof health workforce

As a general rule, digital skills should not be tied to any specific technology but allow every health worker to exploit digital tools and data to improve care and fully partner with patients. The main categories of digital skill sets cover:

- **Operating digital tools** – basic technical understanding of digital tools and solutions as well as how they can be used to support health and health services provision. This includes the capability to support patients in using technology for self-care.



- **Critical appraisal of information and statistics** – understanding of how the data employed by digital tools is collected, analysed, and how the algorithms powering the digital tools use statistics to produce information out of the available data, including the awareness of risks such as biases in data.

- **Digital security** – awareness and knowledge of cyber and information security procedures for storing, sharing, and retrieving health data and other personal information, including knowledge of behaviour in relation to protecting data and information from unauthorised access.

- **Digital health ethics** – ability to understand and reflect on the impact digital technologies have on patients, other health workers, and health services, to be able to effectively address any related ethical considerations by weighing pros and cons of using digital tools and solutions.

- **Life-long learning mindset** – recognition of one's own learning needs and openness to continuous learning; readiness to evolve with changes in the populations' health needs and expectations, as well as with health technology; ability to translate knowledge into continuous practice quality improvement.

2.1.2. The digital skills requirements are more than the commonly recognised digital skills

As discussed in Chapter 1, the emerging digital technologies based on AI and particularly advances in machine learning offer the potential of supporting humans in numerous tasks. Such human-computer tandems could allow for better informed human-led decision making.

Experience from other industries illustrates, however, that the more advanced an automation system is, the more crucial are the skills of the human operator. In particular, the emerging digital tools, especially those based on developments in AI, will give emphasis to skills in counteracting automation bias – i.e. the phenomenon of people favouring suggestions made by automated systems, while ignoring other sources of information (Box 2.3). This bias might grow over time as automated systems become widespread demonstrating their usefulness and convenience.

Therefore, it is important to investigate how to train health workers such that they are aware of the potential automation bias on their side, and know when to rely on the outputs of an automated system and when they should verify them with additional information. In other industries, aviation in particular, technologists have worked together with psychologists to understand and counteract the risks of automation overreliance and complacency. In aviation, this problem is tackled with specific scenarios built into simulator training that promote the right skills and 'appropriately calibrated trust' in the computer systems. The health sector needs to acknowledge this problem and invest in work on training devised to tackle it (Wachter, 2015[49]).

Box 2.3. Automation bias – a troubling picture of human-computer interaction

The more advanced an automation system is, the more crucial are the skills of the human operator.

Humans tend to have bias toward trusting automated systems more than trusting other humans, including themselves – a phenomenon referred to as 'automation bias or the 'irony of automation'. Other industries, where automated decision-making support has been used since decades, provide cases illustrating the hazards of the human tendency for over-reliance on automated systems, once they are introduced into the work environment.

A renowned observational study of experienced commercial pilots in a flight simulator revealed a troubling picture of human-computer interaction. The pilots were confronted with a warning light that pointed to an engine fire, although several other indicators signified that this warning was exceedingly likely a false alarm. All of the pilots participating in the experiment who saw the warning decided to shut down the factually intact engine, which is considered to be a dangerous move. In subsequent interviews, two-thirds of these pilots who saw the engine fire warning described seeing at least one other indicator on their display that confirmed the fire, while there had, in fact, been no such additional warning (Wachter, 2015[49]).

2.2. Digital technologies give new emphasis to interpersonal skills

While digital technology has allowed for means of social connection that have not been possible before, it also often causes a deterioration in the quality of social interaction. In the modern society as a whole, the introduction of new media impacted negatively interpersonal skills - in particular the communication skills - due to a reduction of interpersonal contact, a shift from synchronous to asynchronous communication, and, consequently, a complete elimination of non-verbal communication and cues, which used to make up most of the communication for most of human history.

Although many health workers perceive the potential benefits of digital technology, they also worry that it could have undesired negative effects for patient-provider as well as provider-provider interaction by, for example, distancing health workers from patients and each other, as well as a depersonalisation of care (European Commission, 2018[7]; Antoun, 2016[60]; Davis, 2014[61]; Li, 2013[42]).

One danger is, for example, that health workers are concentrating on a kind of avatar outlined by the data displayed on the screen of a computer or a tablet, instead of concentrating on a person. In inpatient or outpatient settings alike, electronic data systems are often based on check boxes and pull-down menus and as such might standardise and depersonalise patients, meaning that the provider does not create a narrative of the patients anymore, but puts them on a grid and is thus hampered in developing a full picture of a person and her or his needs (Wachter, 2015[49]). Similarly, in the home-care setting, long-term care workers might focus on the information provided by the various mobile apps and web-based solutions, standardising and depersonalising patients.

However, the problems of patient-provider miscommunication and depersonalised care date well back to the pre-digital era. Much have been written about the need to uphold patient-centricity and strengthen interpersonal skills among health workers, in particular skills in patient-centred (as opposed to provider-centred) communication and shared patient-provider decision-making. Shortage of skills in patient-centred communication and shared patient-provider decision-making may contribute to misdiagnosis, delivery of low-value care, waste of resources, and unnecessary frustration among patients and health workers (OECD, 2018[53]).

The increasing presence of digital technologies simply re-emphasises the need for health education and training to pay more attention to the development of the requisite interpersonal skills and the potential for de-skilling. Health workers need to be better equipped with 'tools' for engaging with patients meaningfully and for interpreting patients' narratives for improved diagnosis and treatment planning, just as they learn to interpret various clinical tests and vital signs measures (OECD, 2018[53]; Cenci, 2016[62]).

Patient-centricity and interpersonal skills are key not only to counteracting potential problems of miscommunication, but to provide general foundations for a successful transition away from disease-focused towards person-focused and integrated care. As discussed in Chapter 1, digital technologies can help to activate the most underused resource within health systems, i.e. the patients, by enabling them to take an active part in their treatment and care. This, however, presupposes that health workers perceive patients as partners as well as understand the concepts and the modus operandi of patient-centred communication and shared patient-provider decision making.

Moreover, digital solutions can serve as catalysts for a team-based approach to deliver quality and co-ordinated health services (OECD, 2019[8]). Yet, here again, specific interpersonal skills related to teamwork and interprofessional collaboration are critical for a successful transition to the new and more-collaborative care models. Health workers, however, are often sub-optimally prepared for interprofessional teamwork, as both their education and work experience have been gained in very different (siloed and hierarchical) teaching and care models (OECD, forthcoming[63]). This becomes an even greater concern, as digital technologies often replace the direct provider-provider interactions by looking up of data on a computer, which shuts down all other forms of communication that the programmers did not think of and/or which are difficult to implement into an IT system even though they are completely natural in an interpersonal context. This change might create 'digital silos' to the point that health workers do not address each other even if they are working only meters apart from one another.

Therefore, as digital technologies are increasingly present in the day-to-day practice of care, there is an urgent need to re-instil the core values of professionalism, such as patient-centricity, and adequately reinforce interpersonal skills – for patient-centred communication, shared patient-provider decision-making, and interprofessional teamwork – through reforming education and training (Wachter, 2015[49]).

2.3. There is shortage of individuals with hybrid skill-mix needed to manage the transformation

In most of the EU and OECD countries, health systems lack also a larger cadre of clinician-leaders and managers with a combined understanding of clinical practice, technology, and change management. There is also evidence of a deficit of informaticians or system optimisers with strong insights into health care. However, a successful implementation of digital technologies in health sector requires a sufficiently large cadre of professionals with these hybrid skill-mix (OECD, 2019[26]).

Clinician-leaders and managers with the hybrid skill-mix are essential to ensure the digital technology fits into the realities of health care practice, to build trust in technologies among and engage with the wider health workforce, as well as to manage the culture change needed to drive learning across organisations (OECD, 2019[26]; Sood and Keogh, 2017[64]; The National Advisory Group on Health Information Technology in England, 2016[48]).

Correspondingly, as the informaticians and system optimisers are the people who shape the information that is communicated to and used by the frontline health workers, they should also possess more diverse skills, including a strong understanding of user-friendly design and a sufficient understanding of health care (OECD, 2019[26]).

Moreover, addressing the critical challenges of digital transformation requires policy makers and technologists to work together from the ground up, which means that both groups must understand more of each other's fields. There is a need for creating an environment, where more technologists get involved in public policy and join the teams of policymakers. This calls for more of the joint degree and hybrid education programmes that combine the understanding of, for example, policy, ethics, and digital technology (Schneier, 2019[65]).

3. The changes to the nature of work and the tasks to be done are not always timely appreciated

3.1 Digital technology alone cannot support the transformation of the models of care

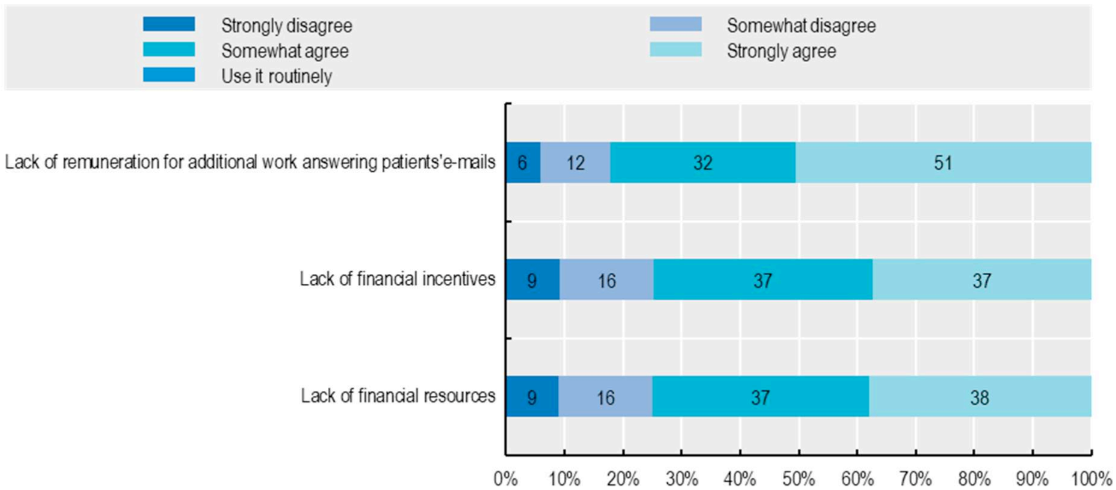
Digital technology only provides the tools and cannot transform the health sector on its own, but requires the creation of an enabling organisational and legal frameworks by policy makers. Even if the technology is designed according to the principles of user-centricity, and the health workers are eager and feel appropriately equipped to use it, there is frequently a need for an extensive re-organisation and 'clear-up' work to adapt the legal, financial and organisational contexts. Indeed, digitalisation can be an effective and efficient motivator and tool for rethinking current processes and workflows in the health sector, and it can give rise to a break with the compartmentalised thinking that is often applied.

However, legislation and regulations are not always adapted for the digital age, or at least not in a timely manner. The common problems include failures to comprehensibly address legal challenges of the use and transfer of digital health data, vague medical liability rules, or even a complete lack of legislation for some of the telehealth services.

This results in numerous unnecessary obstacles to the effective use of digital technology. Even as most of the health data and documents can be created and shared in digital form, they might still need to be printed – in order to be signed by health professionals – and subsequently scanned – in order to be again included in an electronic record. In a similar manner, legal frameworks designed in the pre-digital era prevent the effective use of telehealth solutions. Teleconsultations, for example, can be seen as increasing workload through patients being required to have a face-to-face appointment after the initial electronic appointment (Brennan, McElligott and Power, 2016[52]; European Commission, 2018[7]).

Along with the outdate legislation and regulations, many digitally-enable health services are not timely recognised in the payment schemes. The recent survey of GPs across the EU, for example, indicates that around 80% of GPs face lack of financial incentives to provide telehealth services (Figure 2.2) (European Commission, 2018[7]).

Figure 2.2. Main barriers to effective telehealth adoption as reported by GPs across the EU



Source: (European Commission, 2018[7])

Outdated legislative and financial frameworks also mean that the adoption of digital technology rarely results in the introduction of new, more effective and efficient care models that are also more in line with patients' expectations and preferences. Such changes require a timely appreciation of the changes to the nature of the work, the tasks to be done, and who does them. In particular, the augmented workflows need to be recognised in provider reimbursement models, and regulations need to allow for expanding or reassigning the professionals' tasks and roles (Box 2.4).

Indeed, digital technologies can support or even demand for task-shifting as well as generate a scope for entirely new tasks and roles. In a number of countries, the task of patient triage in primary care has been shifted from GPs to nurses aided by decision-support software (OECD, 2017[66]). In turn, the GPs have taken up new roles, for example, as liaisons in the electronic triage of patients with musculoskeletal problems by hospital-based specialists, upon which patients are either referred by the GP to specialist care or to the management of the problem by a physiotherapist. Such changes require also up-skilling in various clinical areas, e.g. rehabilitation skills.

Box 2.4. New digital care models – adapting legal, financial, and organisational frameworks

Denmark – implementing telehealth model for chronic-wound treatment

Chronic, non-healing wounds, occur due to, for example, diabetes. These types of wounds heal very slowly, with the risk of severe complications, in the worst case leading to amputations. Before the telehealth model had been implemented, the chronic-wound patients were required to contact their GP and were referred to a specialist at a hospital. Since 2015, specialised home-care nurses are responsible for the treatment, which is overlooked and coordinated via telehealth by hospital specialists. The nurses can treat patients at home, in nursing clinics, rehabilitation centres, and retirement homes.

In order to implement the telehealth model, a wide range of issues needed to be resolved, on top of providing the technology for teleconsultations between the nurses and the hospital specialists:

- tasks had to be legally transferred between the hospitals and the municipal home-care services, including expanding the role of home-care nurses to include the wound treatment;
- this change had to be reflected in the payment systems for the hospital services (funded by the regional governments) and the municipal care services;
- hospitals needed to assign the specialists to the new task of providing tele-assistance to the nurses and assign time to this task in the workflows;
- similarly, the new task had to be included in the workflows of the home-care nurses;
- the nurses had to complete a specialised education programme (and an annual follow-up course), for which funding and time needed to be secured;
- General Practitioners, who normally referred the wound patients to the treatment, also needed to recognise the change in the care model.

None of these changes could have happen by simply introducing the technology. But none of them could have happened without it, either.

Source: (Healthcare Denmark, 2018[16])

3 Empowering health workforce to make the most of digital transformation

KEY MESSAGES

Governments need to provide foundations for trustworthy, ethical, and human-centred digital transformation to ensure support among health workers. This includes:

- leading with an overarching and human-centric digital health strategy, including a framework for coordination among all the decision-making actors;
- advancing evaluation of and regulatory safeguard for digital technologies;
- promoting user-friendliness to avoid technology getting in the way of work.

Health-sector workforce skills need to be advanced to enable safe and effective use of digital technologies, which calls for:

- including digital skills in the core content of health education and professional training and merging the ‘high-tech’ with the ‘high-touch’ skills;
- allowing dedicated time and flexible ways for up-skilling for the current health workers;
- creating hybrid skill-mix programmes to better equip clinician-leaders and managers with understanding of technology as well as informaticians with understanding of health care.

The existing models of work and the related legal and financial frameworks need to be timely adapted to allow technology to add value. This includes:

- developing structures inside governments to incubate new approaches and ensure the timely revision of laws, payment systems, and organisational frameworks;
- ensuring attractive jobs exist within the health sector for professionals with the hybrid skill-mix, who are needed to manage the transformation.

Based on the issues described in Chapters 1 and 2, this Chapter discusses policy actions the governments of the EU and OECD countries can undertake to enable a successful digital transformation of health systems, in particular to overcome the health-workforce related barriers.

1. Providing foundations for trustworthy, ethical, and human-centred digital transformation

1.1 Leading with an overarching and human-centric digital health strategy

A successful digital transformation amounts to a health system-wide reorganisation, and, as such, it requires leadership and the setting of an overarching strategy in consultations with all the stakeholders.

Countries that lead in harnessing digital opportunities as well as in positive perceptions among health workforce, such as Denmark, Finland, or Sweden, have one thing in common: a long-standing tradition of human-centric and overarching digital health strategies that articulate the intersection between the technology and health, with focus on patients' and health workers' needs.

The digital health strategies in these countries have been developed through consultation across all actors and form a common framework for coordination, where the parties agree to prioritise specific initiatives in the short and longer-term. These strategies also are part of a cross-sectoral digital strategy and as such support joint initiatives in the areas where there are interdependencies across different sectors, such as health and education. The strategies, including the process of devising them, are used to engage and communicate with the stakeholders across the health system and the public about the broad directions and the progress in implementing digital technologies for health.

While most countries have formulated digital health strategies, they are not always overarching (i.e. cover different digital health technologies separately), focus on technical aspects instead of patients' and health workers' needs, and are vision documents falling short of describing consolidated action plans, roles and responsibilities of different actors, and funding support towards the implementation of various goals. Ambitious and concrete digital health strategies, such as the ones that have been developed in Denmark, Finland and Sweden, should articulate:

- how the implementation of the various digital technologies collectively supports the broader health system objectives, in particular patients' and health workers' needs;
  - this includes a clarification how the strategy is informed by current health-system challenges and a more profound understanding of the patients' and health workers' needs;
- a number of focus areas and the related specific initiatives, which the stakeholders jointly implement during the strategy period;
  - these are usually selected from among successful pilot projects and through mission-oriented competitions, in which local innovators can pitch solutions to problems identified by the government and be awarded funds to develop the proposed solution;
- measures and initiatives aiming to support interoperability and user-centred design of digital tools and solutions;
- commitment to strengthening of health worker's digital skills by including digital health into the core content of health education and training;
- commitment to review the existing legal and financial frameworks that may be blocking the way to the effective implementation and use of digital technologies;
- measures and initiatives addressing the risk of digital technologies exacerbating the social divides due to, for example, low digital literacy among some groups of patients;
- commitment to continuous improvement and adaptation of the health-sector digital infrastructure and data systems, especially in view of maintaining data security.

The strategies should also communicate a long-term vision, going beyond the usual single strategy timeframe of four to six years, to safeguard and continuously modernise the common digital infrastructure such that it evolves into a unified digital ecosystem; this means an open and supplier-independent common network consisting of mutually supporting services and components linked by common standards and principles. In such a unified digital ecosystem, the benefits of the different digital tools and solutions reinforce each other and collectively strengthen the health system performance. This also provides a secure and flexible foundation for incorporating any further digital health innovations that cannot be foreseen at present.

1.2. Advancing evaluation and regulatory safeguards to ensure positive impact of digital technologies

A successful digital transformation, will also require addressing health workers' questions about the value digital technologies produce in health care as well as their demands for appropriate safeguards against potential undesired effects of the use of digital technologies, AI in particular, including the possible lack of transparency or threats to data privacy.

The transformative potential of digital technologies implies huge prospective benefits but also risks and the possible diversion of resources to ineffective digital tools. Hence, their implementation needs to be accompanied by robust evaluation and monitoring to assess their true impact on prevention and health care. This is particularly the case for more disruptive technologies, such as Artificial Intelligence, for which knowledge about the consequences is limited when first implemented and any undesired effects cannot be fully anticipated and averted. Once a technology is widely used, the consequences become known, but it might be difficult to adapt the technology or the legal and organisational environment to timely counteract any undesired effects. Moreover, bad experiences in the field will harm acceptance and trust among health workers also after effective countermeasures have been implemented.

Depending on the technology, there are two solutions:

- to increase knowledge of benefits and risks at initial stages of the development and use of a new digital technology. This can be realised through **advancing the methods for systematic evaluation of the impact of digital health technologies**, which, at present, are largely based on methods primarily developed and used for pharmaceuticals
- to increase social control over technological trajectories through **regulatory safeguards and monitoring for digital technologies**, Artificial Intelligence in particular, during their life-time.

1.2.1 Advancing the methods for systematic evaluation of digital health technologies

Decisions to use and reimburse digital health technologies are ideally based on evidence that asserts whether their benefits outweigh the associated costs. Assessment and evaluation is, therefore, needed and usually preformed before the wider implementation.

However, the assessment and evaluation methods are largely based on the evaluative framework primarily developed and used for pharmaceuticals. They may be feasible and desirable in some cases, but not in others. Given the diversity of digital health technologies (ranging from electronic records to mobile device apps, to algorithms designed to assist in detecting cancers), their consequences can differ substantially not only from the consequences of pharmaceutical therapies, but also case by case. Insufficient assessment and evaluation methods can be a barrier to adoption, as practitioners might not be able to clearly see the benefits, or can lead to inefficient allocation of resources (EXPH, 2019[33]).

While important frameworks and guides for the evaluation of digital health technologies have been proposed in recent years (JAseHN, 2017[67]; WHO, 2016[68]), new approaches are required to take a broader perspective and capture all relevant changes. The new primary-care telehealth models for patients with chronic conditions, for example, can have a spill-over impact on population health at the practice level and not only the enrolled individual patients, or can have system-wide effects by allowing home-based in place of hospital-based care. Moreover, due to the adaptive nature of the digital transformation, two – or more – digitally supported service models together might outweigh the associated costs of their introduction, while one alone – or all but one – might not. Implementing and assessing impact of, for example, EHR only in primary care or only in hospitals might have different impact from a scenario when interoperable EHR are implemented across both service settings. Hence, it is important to carry out together the assessment for all digitally supported services that are contingent on one another.

Further investment in the development of methodologies at the national level as well as a European repository for evaluation methods and evidence of the impact of digital health technologies is recommended. Countries could incentivise the development of new methodologies by, for example, including this requirement in the publicly-funded projects piloting digital tools and solutions. A European repository containing evaluation frameworks, methods, tools, as well as completed and ongoing evaluations, could facilitate optimising the exchange of knowledge at the EU level and could lead to a continuous improvement of the methods (EXPH, 2019[33]). Moreover, governments can consider establishing organisations or structures within existing organisations dedicated to the development of methodologies and rapid evaluation.

1.2.2 Regulatory safeguards for the use of digital technologies in the health sector

The workers and patients also demand appropriate safeguards against potential undesired effects of the use of digital tools, including the possible threats to data privacy or lack of transparency.

Protecting health data and putting them to work are not mutually exclusive – both can be achieved with strong data governance frameworks. Hence, the national regulators and policy makers need to accelerate progress towards the adoption of such frameworks. Substantial progress has been made in reconciling the risks and benefits of data-driven digital technologies, especially through laws and guidelines at the EU level, such as the General Data Protection Regulation (GDPR) that came into force in 2018. The EU is now the most advanced region to promote the sharing of health data across national borders while continuing to protect privacy. Countries are further supported through guidelines being developed by the European Data Protection Board (EDPB), which includes representatives from the data protection authorities of each member state.

Moreover, the 2017 OECD Council Recommendation on Health Data Governance (OECD, 2019[12]), provides a mechanism for further harmonisation of the national health data policy and governance frameworks to create a global information ecosystem that can securely extract knowledge from an even larger pool of health data. The major hindrance, such as the existing legal barriers and lack of agreement on data standards and exchange formats both within and across countries could and should be removed (OECD, 2019[2]).

The governance of data sharing and privacy protection, however, is s fast-moving field, where new questions arise continuously with the development of new data-driven digital innovations. This requires a deeper, ongoing discussion and the development of dedicated, clearly articulated ethical frameworks and charters. The European data strategy newly announced by the European Commission in February 2020 is a step in this direction (see also Box 1.4 in Chapter 1).

Moreover, the recent developments in AI have attracted much attention among health professional associations. A central question in this debate is how to balance the opportunities and risks, by ensuring that the use of AI in the health sector is transparent, ethical, free of bias, and does not lead to undesirable outcomes (OECD, 2019[13]).

The public will only be able to have confidence in the technology's development and its applications when a clear and comprehensive legal framework for achieving its trustworthiness is in place. The existence of such legal frameworks will be key for realising the potential of digital technologies, AI in particular, in the health sector (OECD, forthcoming[69]; AI HLEG, 2019[70]).

The 2019 OECD Recommendations on Artificial Intelligence (OECD, 2019[35]), the first international standards agreed by governments for the responsible stewardship of trustworthy AI, can guide countries in establishing such legal frameworks. Not every use of AI presents the same risks, and the costs of building transparency and accountability into an AI system should be balanced against the system's potential harm. The health sector, however, represents a high-stakes context and as such, requires high degrees of transparency and accountability. In high-stakes contexts, it will be important not only to evaluate AI systems throughout their life cycle, but also to ensure early on that their design is ethical and unbiased, as it will be more costly to address issues later during implementation (OECD, 2019[71]).

Other public sector services provide inspiring examples. The Government of Canada's Directive on Automated Decision-Making, for example, operationalises a set of principles to ensure standards and a consistent approach to risk management in applications of AI across the Federal Government organisations. The Directive provides a risk-based approach to ensuring the transparency, accountability, legality and fairness of AI, and imposes certain requirements, both in the design and the implementation stage. The Directive incudes an Algorithmic Impact Assessment that evaluates the potential impact of an algorithm on the public and enables officials to put in place mitigation where risks are highest (Box 3.1). The Directive is the first of its kind in the world and has taken effect from April 2020.

The Directive empowers not only the authorities but also third parties (private sector or civil society) to raise important questions about the proposed AI system, which the developers are required to answer. It also requires government organisations using AI in their decision-making process to release the custom source code of the algorithms to the extent possible, and to provide people with applicable recourse options to appeal against the decisions, among other things. In addition, the government organisations have adopted a new procurement process, which has resulted in a list of pre-qualified suppliers of AI expertise that were evaluated in part on their ability to design and implement AI solutions in line with the Directive's requirements (OECD, 2019[44]).

Importantly, the Directive and the Assessment Tool have been developed in an open and participatory manner. Stakeholders from all sectors and members of the public were invited to provide comments. This enabled feedback from academia, civil society organisations, private businesses, and interested individuals to be incorporated during the development process. Moreover, the Directive will be subject to a review process every six months (OECD, 2019[44]; Government of Canada, 2019[72]). The latter illustrates the need for regulatory frameworks to become more adaptive, i.e. shift from 'regulate and forget' to a responsive and iterative approach.

Beyond the regulatory action, there is also a need for health professional associations to update their ethical codes in a timely fashion, such that health workers have answers to questions about how to work with machines and also to inform the development of education and training content in, for example, digital health ethics (see also Section 2.1 below).

Box 3.1. Transparent and accountable use of AI in the public sector – Canada's Algorithmic Impact Assessment Tool

The Algorithmic Assessment is a questionnaire that evaluates a public-facing AI system by assessing the decisions the system has the capacity to inform or make and the potential harm to people. The results of the questionnaire generate an impact rating on a scale of 1 to 4, where 1 indicates decisions leading to impacts that are brief and reversible and 4, where decisions lead to impacts that are irreversible and significant. This rating establishes the minimum level of responsibility for the organisation and assigns mandatory governance, oversight, and reporting requirements.

Sample questions include:

- Is the project within an area of intense public scrutiny?
- Are clients in this line of business particularly vulnerable?
- Will the algorithmic process be difficult to interpret or to explain?
- Will the system be replacing a decision that would otherwise be made by a human?
- Are the impacts resulting from the decision reversible?
- Who collected the data used for training the system?
- Will you have documented processes in place to test datasets against biases and other unexpected outcomes?
- Will the system be able to produce reasons for its decisions or recommendations when required?
- Will the system enable human override of system decisions?

Based on the answers to these and other questions, the assessment specifies the required response. For example, it determines the extent to which there is a need for:

- peer review of the system
- public notice about the system
- human involvement during the decision-making process
- explanation of how decisions are made
- testing the system and monitoring the outcomes for undesired effects, such as bias
- contingency planning
- approval to operate

Source: (OECD, 2019[44]); https://canada-ca.github.io/aia-eia-js

1.3 Promoting user-friendly design to avoid technologies getting in the way of work

The user-friendliness of digital technologies is key to maximising their benefits and one of the major drivers of their adoption. Yet, the experience to date shows numerous examples of technologies that instead of aiding the work of health professionals, get in its way. Most challenges result from a failure to adequately engage end-users in the design process and understand the complexity of work in health care.

Methods for the effective involvement of end-users in design and implementation of a digital health technology are well-developed, but this know-how is rarely applied into practice. The methods – commonly referred to as human-centered design or human-factors approaches - aim to aid the understanding of human-computer interaction, organisational context of use, and the complexity of tasks to be undertaken, in order to increase the probability of identifying and rectifying negative unintended consequences before the technology is released into a healthcare environment (Turner, Kushniruk and Nohr, 2017[51]). It has also been shown how to incorporate these methods into the selection of vendors within the public procurement process (Jensen, Rasmussen and Lyng, 2013[73]).

Hence, there is a need to further strengthen regulations regarding digital health technology design, such that producers face incentives to meaningfully engage with the end-users and the public procurement of digital tools and solutions includes user-friendliness among the selection criteria. Vendors in the EU are already required to apply certain validated user-centred design techniques to comply with the European Medical Device Directive. However, studies indicate that there are misconceptions about user-centred design among vendors and little is known about how vendors comply with the requirements in practice (Turner, Kushniruk and Nohr, 2017[51]). This highlights the need for more precision in and better enforcement of the existing regulations.

Countries can also issue detailed guidelines for the producers, including not only recommendations regarding interoperability and standardisation, but also how to engage end-users in the design – as done in Estonia, Denmark, or Switzerland (OECD, 2019[3]). Countries could also consider collecting information on user experience with digital tools and solutions and establish an adverse-events reporting to improve knowledge of problems and inform work on the solutions. In Finland, for example, authorities have engaged in repeated national surveys with clinicians to identify the state of EHR usability, differences between vendor products, and options for improving the EHR systems (Turner, Kushniruk and Nohr, 2017[51]).

It also has to become easier for health workers and patients to navigate the ever expanding universe of digital health technologies. Hence, each digital health tool or solution needs to be not only easy to use, but also follow interoperability and terminological compliance requirements, such that when new technologies become available they can be easily integrated with the use of the existing ones. For rapidly developing segments of digital technologies, such as mobile health apps, guides to recommended apps are needed for health workers as well as patients to ease the choice and maximise the benefits.

Box 3.2 provides examples of the above-discussed initiatives as planned or implemented in Denmark.

Box 3.2. Denmark – continuously promoting user-friendliness and a transition towards a unified digital ecosystem

In its current digital health strategy 2018-2022, Denmark recognises that the acceleration in the development of digital health technologies creates a need to better control, prioritise, and coordinate the adoption of new tools and solutions to maintain a focus on the main goals of digital transformation: putting patient needs first and making daily workflows easier for health workers. To address the challenges the following initiatives have been put forward:

Continuously increasing user-friendliness of digital tools and solutions – includes initiatives to collect data about health workers' and patients' experience with various digital health tools and solutions to inform the work on improvements as well as the design of new technologies. Moreover, the requirements for new or upgraded digital tools and solutions have been tightened with regard to, for example, testing with end-users, accessibility by people with disabilities, or accessibility and use on mobile devices and not only computers.

Improving digital workflows in primary care – is an initiative aiming to optimise digital data systems in primary care by developing a number of new standards and functions, based on insights into common problems faced by General Practitioners (GPs) with handling increasing volumes of information. The initiative includes, for example, functionalities for quicker patient data overview, better preparation for consultations through questionnaires, an intelligent inbox, and a better framework for cooperation and communication with hospitals and municipal health services. The new standards and functions will have to be implemented by all suppliers of IT systems for primary care, so that all GPs who wish to work with the new digital workflows can do so, regardless of which data system they use.

Creating a guide to recommended digital health apps – is an initiative responding to the rapid development of digital health apps for smartphones and tablets, which provides new opportunities, but also makes it difficult for patients and health workers to navigate the wide selection. The initiative aims to develop an evaluation-based guide to recommended apps, providing a better overview of which apps offer a valuable supplement to patient treatment and care, effectively support health promotion, and meet personal data-security requirements.

Continuous modernisation of the digital architecture to support transition towards a unified digital ecosystem – includes testing new ways to roll out common standards for cross-sector communication and to develop the national digital architecture into a unified but flexible ecosystem. The aim is that the standards and the architecture serve as common building blocks that can flexibly connect various digital components that continue to be developed locally, on their own terms, and in an open and vendor-independent manner.

Source: (Digital Health Strategy - Denmark, 2018[17]; Danish Government, Local Government Denmark, and Danish Regions, 2016[18])

2. Developing human expertise and skills to enable digital technologies to add value

2.1. Including digital skills in the core content of health education and training and merging the 'high-tech' with the 'high-touch' skills

All front-line health workers will be exposed to digital tools, offering information, automated decision support, and new options for engaging with patients as well as collaborating with other workers across the system. As discussed in Chapter 2, there is, however, growing evidence of digital skills shortages as digital health is frequently only included as an elective course in the health education or professional training or not taught at high enough level.

Hence, there is a need to add digital health to the core content of health education and professional training programmes and invest in creating modern and comprehensive digital-health curricula. Denmark, Finland, and Sweden, for example, have included in their current digital health strategies a commitment or a legal provision to add digital skills into the core content of education and training of all main categories of front-line health professionals in primary, secondary, and long-term care (Digital Health Strategy - Denmark, 2018[17]; OECD, 2019[26]).

In most of the EU and OECD countries, education institutions and/or professional associations lead the transformation of the detailed health educational and training curricula, based on minimum regulatory requirements (OECD, 2019[26]). With regard to digital skills, there has been an ongoing research effort in the development of competency frameworks, both at the national level as well as within international projects, such as the *Joint Action to support the eHealth Network* (JAseHN) at the EU-level and the *2016-2018 EU-US eHealth Work Project*.

However, progress in building or modernising the digital health curricula has been slow and uneven. The identified digital skills for front-line health workers diverge between research groups, institutions, and countries. Moreover, the focus is frequently on skills requirements for merely operating digital tools or understanding of digital data security, with less recognition of skills is digital health ethics or the critical appraisal of information and statistics. With regard to the latter, there might be convergences with other subjects, such as evidence-based medicine, on which the digital health education could build to avoid repeating the efforts.

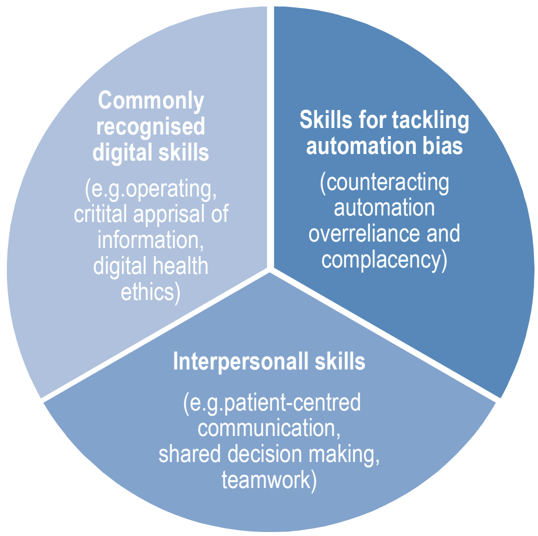
Moreover, the problem of automation bias needs to be better acknowledged, and the ways for counteracting it through, for example, building awareness and simulation training, still need to be devised and incorporated into the digital health curricula. It is also essential to adapt training in specific interpersonal skills to balance the negative impact digital transformation can have on patient-provider and provider-provider communication and interaction. In short, skills needed for the safe and effective use of digital technologies in health care go beyond the commonly recognised digital skills (Figure 3.1). Finally, digital health cannot be presented as a standalone topic, but needs to be integrated across subjects to build the perception of digital technology as an integral component of health care.

In view of all the above challenges, equipping health workers with all the skills required for digital transformation will entail substantial effort on the part of the educators. This effort should not be unnecessarily repeated by the educators within each professional group, since all main categories of front-line health workers are similarly affected by digital transformation.

To aid educators and to ensure a uniform approach, governments in some countries – for example, Norway, Switzerland, and the United Kingdom – funded independent and inter-disciplinary expert reviews to assess how technological and other developments (genomics or demographics) are likely to change the skill requirements and to inform the necessary changes in the health education and the training, taking into account the national context (Health Education England, 2019a[74]; Confédération suisse, 2017[75]; Ministry of Education and Research of Norway, 2017[76]). A similar review is underway in Canada (OECD, 2019[26]).

Figure 3.1. Skills needed for the digital era go beyond the commonly recognised digital skills

Combining 'high-tech' and 'high-touch' skills



Based on such a review, the Swiss Competence and Coordination Centre of the Confederation and the Cantons (eHealth Swiss), for example, has published detailed guidelines for educators on how to integrate digital health topics into the education and professional training of the main categories of health workers (eHealth Suisse, 2017[77]). eHealth Suisse leads also a national coordination group on digital health education with members including educational institutions as well as representatives of professional associations and umbrella organisations of the health sector employers, to ensure that broader perspective is taken in informing the guidelines for changes in health education and training.

To provide further support to the educators, countries can also consider funding interprofessional platforms for the exchange of knowledge about development of digital health curricula and best practices in education and training for the digital era, as done, for example in Canada and Denmark Box 3.3. These initiatives provide also a unique opportunity to break the professional siloes and bring together educators from across the health sector, supporting other initiatives, such as those aiming at wider adoption of interprofessional health education. Such platforms could be established at the EU level to further optimise the exchange of knowledge and adoption of best practices.

Box 3.3. Ensuring a uniform approach and supporting the educators through interprofessional platforms for exchange of knowledge and best practices in digital health education

Canada Health Infoway – an independent, not-for-profit organisation, fully funded by the federal government – has an almost one-decade-long history of providing financial support for initiatives led by educational and accreditation bodies to help prepare the future health workforce, including for digital transformation.

Initially, Infoway sponsored the Association of Faculties of Medicine of Canada (AFMC) initiative to better prepare medical students to practice in a digitally enabled context. Its work led to the development of the digital health competencies for undergraduate medical education and the AFMC Infoway eHealth Workshop Toolkit Collection. Infoway has also worked with the Canadian Association of Schools of Nursing (CASN) and the Association of Faculties of Pharmacy of Canada (AFPC) on similar initiatives aimed at improving the preparedness of nursing and pharmacy graduates to work in a technology enabled environment.

Over time and in partnership with the above-mentioned educators' organisations from across medicine, nursing, and pharmacy, Infoway has developed the *Digital Health Faculty Associations Content & Training Solutions* (FACTS) initiative. The FACTS program engages the faculty and students from 17 Faculties of Medicine, 10 Faculties of Pharmacy, and 94 Schools of Nursing to scale and spread education in digital health, promote an interdisciplinary and cross-sectoral approach, as well as develop practical resources for faculty and students to employ digital tools toward interprofessional, collaborative patient care.

Since 2018, similar efforts have been funded by the **Danish Agency for Science and Education** and undertaken within the Steering Group for Health Professions Education. Along with the development of digital competency frameworks for medicine students, the platform also included an interprofessional project that produced a unified digital competency framework for nine other categories of health workers, for example, midwives, physiotherapists, and nutritionists.

Source: (OECD, 2019[26]; Styregruppen for Sundhedsuddannelsernes, 2019[78])

Moreover, in recognition that health education curricula can easily become too static and fail to timely adapt to the various changes taking place in the health services delivery, the Norwegian Government has established a new governance system for determining learning outcomes in health education programmes. The new system ensures a regular review of the curricula and increases the influence of actors other than health educators, such as health sector employers as well as students. The reform is a cross-governmental collaborative effort of the Ministry of Health and Care Services, the Ministry of Education and Research, the Ministry of Children and Families, as well as the Ministry of Labour and Social Affairs (Box 3.4).

Finally, for the emerging digital technologies, AI in particular, it will be important to support the educators by including them in the research teams working on the projects piloting the use of new technologies. The engagement can be secured, for example, by including a formal requirement for the research projects, funded (or co-funded), from public resources, to produce not only evidence on performance and outcomes of the technology, but also inputs for the development of the health education and training content.

Box 3.4. Involving employers and students in the design and review of health education curricula in Norway

Since 2018, the Norwegian government has been restructuring National Curriculum Regulations in health and welfare education with the aim to ensure more effective and timely revision of the curricula in view of, for example, developments in digital health technologies, new professional knowledge, changing demographics, or major service delivery reorganisations.

One of the key features of the new governance system is the establishment of programme groups for each programme of education, of which half of the members come from higher education institutions, and the other half represents employers in health and social care. Each group also includes a student representative. The programme groups are tasked with preparing curricula and, later, reviewing as well as revising them, if needed. The groups operate within RETHOS – a project organised under the Ministry of Research and Education.

The curricula include the learning outcomes, the structure of the programme, and requirements regarding the practice-based parts of the studies. The learning outcomes are formulated in accordance with the National Qualifications Framework and define the minimum requirements relating to the graduates' final competencies. The curricula are phrased on a medium level of detail to allow leeway for possible local adaptations at the higher education institutions.

So far, the new governance system covers the national curricula for education of 20 categories of health and social care workers, including dentists, general nurses, physicians, physiotherapists, or social workers.

There are also plans for RETHOS to cover specialisation programmes in the near future.

Source: RETHOS, Ministry of Research and Education, 2019.

2.2. Allowing dedicated time and means for up-skilling for the current health workforce

In the majority of countries, the pace of changes has been particularly slow with regard to whether and how the Continuous Professional Development (CPD) and other on-the-job training include digital health content (OECD, 2019[26]).

Most often, suppliers of the technologies provide a one-off training to the health workers, but these frequently address only basic operational issues and are technology specific. In the public sector, health workers often lack even basic one-off training support as major digital systems, such as electronic records, are being introduced (OECD, 2019[26]). Despite the clear need for allowing health workers to learn about and get used to using a new system, investments in rolling out digital health services infrastructure are rarely accompanied by the investments in training of the current health workforce. Estonia, Denmark, and Australia provide examples of exceptions from this general omission trend (Box 3.5).

Box 3.5. Combining national implementation of digital health services infrastructure with dedicated training for the current health workforce

Estonia provides an example of coordinated investments in both the rolling out of digitally-enabled health services and in the development of the requisite digital skills of the current health workers. In the beginning of 2020, Estonian Ministry of Economic Affairs and Communications announced publicly funded training courses, which are aimed at the primary care physicians and nurses as well as resident physicians, and scheduled to start in 2020. The courses will be delivered by the Tallinn University of Technology.

A similar initiative has been effected in **Denmark** during the national implementation of telehealth services for patients living with COPD. The funding for the implementation (provided jointly by the national, regional, and municipal governments) included costs of devising and providing training to the health workers affected by the new service model, including also the cost of re-training the trainers. The training was provided by a public vendor and based on the insights regarding skills needs from the initial pilot of the telehealth services.

The Australian Government's Digital Health Agency – a body responsible for all national digital health services and systems across the health sector – in addition to funding the digital health services infrastructure, also provides free and on-demand training to health care organisations, which have implemented the national EHR system or plan to do so. In addition, the Agency has developed a range of on-line software demonstrations as well as training platforms for health workers interested to undertake self-paced learning. Health professionals can, for example, familiarise themselves with all the digital health functions in their new EHRs software without the need for a real patient.

Source: (Australian Digital Health Agency, 2019; (Healthcare Denmark, 2018[16])

CPD and other training systems vary with regard to whether participation is obligatory and whether health workers have work time allotted to the up-skilling activities. Moreover, the usual activities are participation in seminars and workshops, in particular for doctors, with (self) e-learning opportunities being less common (European Commission, 2018[7]; OECD, 2019[26]).

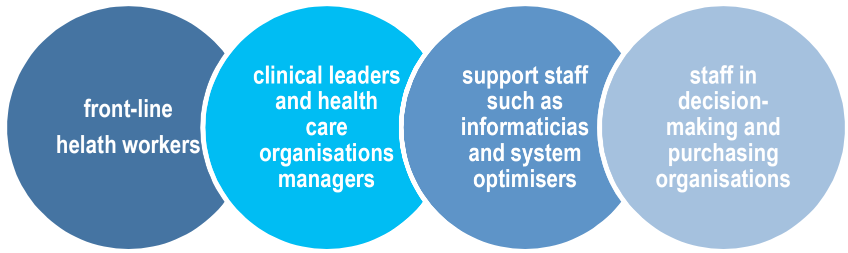
To meet the current demand for digital up-skilling, the CPD and other professional training schemes should become a shared responsibility between employers, professional organisations, and ministries of health. Only in this way, it will be possible to create more systematic and organisational support that ensures up-skilling for all categories of health workers as well as that they can take time off for the training and that its costs are not prohibitive (OECD, 2019[26]; European Commission, 2014[79]). Moreover, the availability of flexible (self) e-learning training has to be further improved, especially as health workers differ with regard to digital skills and experience in working with digital tools and solutions.

2.3. Creating new hybrid educational programmes to manage the transformation

It is crucial not only to up-skill the front-line health workers, but also to address the digital skills gaps among the other main categories of professionals within the health system. As discussed in Chapter 2, this includes clinical leaders, managers, and support staff, such as informaticians in health care provider organisations as well as the staff in the decision-making and purchasing organisations (Figure 3.2).

The clinician-leaders and managers increasingly need to combine their understanding of clinical practice with that of technology and change management to ensure the digital technology fits into the realities of health care practice, to secure the buy-in from the front-line health workers, as well as to manage the culture change needed to drive learning across health care organisations.

Figure 3.2. Up-skilling is needed among all main categories of workers within a health system



Some countries are already making progress in the development of education programmes (as well as of the corresponding jobs with sustained career pathways) that closely tie clinical or managerial leadership and digital-technology content. In the United Kingdom, for example, the NHS England Digital Academy aims to upskill the current clinical leaders and chief information officers working in the NHS health care provider organisations (Box 3.6).

Box 3.6. Investing in upskilling of clinical leaders and managers – NHS England

In 2017, the **NHS England** has commissioned the NHS Digital Academy with the aim of developing a new cadre of at least 300 clinical and IT leaders to support the digital transformation of the NHS. With funding of GBP 6 million, the Academy is delivered by a partnership of the Imperial College London, the University of Edinburgh, and the Harvard Medical School.

The Academy provides a year-long, fully accredited and funded programme (Post-Graduate Diploma in Digital Health Leadership). The programme combines content in leadership and change management, health informatics and data analytics, health systems and user-centred design, as well as citizen informatics, among other subjects. In order to be considered for the NHS Digital Academy, applicants are required to have executive level support from their NHS organisation.

Source: (NHS England, 2019).

In addition, the informaticians and system optimisers should gain stronger insights into health care as they shape the information used by the front-line health workers. While programmes in Clinical Informatics have existed in the majority of the countries for some decades now, the field has primarily focused on the collection, handling, and processing of health information (usually patient records) for administrative purposes. Only more recently, Big Data and a shifting focus on population and patient outcomes have directed the field towards work aiming at improving the effectiveness and efficiency of health services delivery, with many of the existing study programmes changing their curricula and accreditation standards. There are also examples of entirely new programmes, benefiting from dedicated funding provided by the ministries of education. Tallinn University of Technology, for example, offers a unique Master's programme in Health Care Technology that combines knowledge of digital health technologies, financing and change management in health care, as well as medical law and ethics, among other subjects (OECD, 2019[26]).

A deeper understanding of digital health technologies is also critical for selected staff in institutions governing health systems at the national and local level. This need has started to be recognised in a number of countries already. In Canada, the Digital Academy, a teaching organisation hosted at the Canada School of Public Service, offers a new curriculum focussing on data, digital technology design and development to support up-skilling of the current civil service staff. The Academy uses real-life challenges along with a mix of events, online learning, and podcasts. In Finland, the government is in the process of creating a Centre of Excellence for AI, a virtual university and a Masters programme in AI, to strengthen the talent pool for both the private and public sectors (OECD, 2019[44]).

3. Adapting models of work and the related legal and financial frameworks for the digital era

3.1. Developing structures to ensure timely revision of laws, payment systems, and organisational frameworks

Digital transformation is critically dependent not only on the increasingly widespread presence of digital tools and solutions in the health sector, but also on whether their presence results in the development of new forms of cooperation and models for how health services are provided. However, the existing models of work together with the underpinning legal frameworks and payment systems have been frequently designed in the pre-digital era and might not leave room for accommodating the new tasks, workflows, and services.

As discussed in Chapter 2, situations when, for example, e-prescribing systems exist but cannot be effectively used since the existing laws still require the clinicians to issue paper-based prescriptions lead not only to inefficiencies, but can have lasting negative effects on the health workers' attitudes towards digital health technologies in general. Similarly, if new telehealth services are implemented but not included in the list of reimbursed services, it cannot be a surprise that health professionals quickly forget all about them. Even if the laws and the payment systems are finally revised, the memory of insufficient regulations contributes to negative perceptions of the technologies, also among the public.

Hence, once the user-friendly digital systems are in place and the pilots of new digitally-supported health service models demonstrate their safety and cost-effectiveness, it is necessary to support their use and wider implementation with adequately adapted legal, financial, and organisational frameworks. New digitally-enabled health services, for example, need to be adequately recognised in provider payment systems. Similarly, if digital technology augments health workers' tasks and roles, regulations need to allow for expanding or reassigning these tasks and roles. The implementation of digital technologies by health-care organisations needs to be planned, as, in most cases, it takes a considerable amount of time of front-line health workers, which must be accounted and allowed for.

To ensure a timely adaptation of the work models and the related legal and financial frameworks, there is a need to develop dedicated structures inside governments to incubate new regulatory approaches. This work should involve a thorough review and understanding of the current health services design and the pertinent existing regulations, looking for those that might be blocking the innovation. This also includes identifying tasks that are no longer required, new tasks that are needed, and the implications for the health service design.

The Danish Ministry of Health, for example, has created a task force dedicated to reviewing and if necessary modernising all the legislation, regulations and guidelines for health service delivery, in the wake of disruptive digital health technologies and potential for new digitally-enabled models of care. This includes not only updating existing laws or payment systems and evaluating the need for entirely new ones, but also cutting the number of regulations to simplify the overall legal framework. Depending on a concrete problem at hand, teams working on the reviews include external policy analysts, field experts, or technology developers. Depending on the technology's application, the field experts include professions like sociologists and psychologists.

Moreover, a broader implementation of the more disruptive digital health technologies, such as AI, will require entirely new approaches to regulation and departments dedicated to developing them. Outside the health sector, numerous government agencies are already making progress in setting up dedicated teams that embrace the new adaptive regulation approaches (as opposed to the 'regulate and forget' approach). Adaptive regulation relies more on trial-and-error and rapid feedback loops, which lead to more responsive and iterative process of designing regulatory frameworks. The adaptive approach also relies on co-design of regulation and standards in collaboration with the representatives of the industry.

3.2. Matching skills supply and demand

The supply of professionals with new skills mix for the digital era needs to be matched with demand for such professionals, especially within the public organisations of the health sector. As discussed in Chapter 2, ensuring the support for digital health technologies among the front-line health workers, for example, strongly relies on adequate leadership at the organisational level, i.e. the clinician-leaders and managers with combined understanding of clinical practice and digital health technology as well as change management.

Creating a larger cadre of clinician-leaders and managers with hybrid skill-mix to manage digital transformation, for example, will not bring much, unless the supply of such skills is matched by demand for these professionals among health care organisations. Without the availability of full-time jobs with a sustainable career track, few talented individuals will choose to leave the practice of medicine, nursing, or pharmacy to obtain additional training and certification in digital technology. The same applies to informaticians or system optimisers, who will not be interested in obtaining additional knowledge of health care, if the sector does not offer attractive jobs for them. Similarly, positions for professionals combining expertise within the field of health systems management and digital technologies will need to be created within the organisations governing the health sector.

Therefore, strategic, coordinated and sustained resourcing is needed to ensure new positions are available within the health sector and offer attractive career paths. At present, under the activity-based or population-based funding, health care organisations do not face incentives for employing, for example, Chief Information Officers (or at least not in a full-time capacity) or additional informaticians to provide adequate system support. For the clinical leaders or managers, obtaining additional qualification in digital health technology frequently does not lead to any revision of the job description nor does it open a new career path. In general, there is low recognition of importance of digital skills among managerial and leadership-level staff across the health sector, including within the Ministries of Health, which translates into limited availability of jobs that could attract individuals with skill mix adequate for the digital era.

3.3. Health workforce planning for a digital future

Health workforce planning aims to achieve and maintain a balance between the supply of and the demand for different categories of health workers. Workforce planning in the health sector is particularly important, given the time and cost involved in training the main categories of health professionals. Proper health workforce planning is needed not only to guide policy decisions on entry into health professional education programmes, but also to assess the impact of possible re-organisations in health service delivery to better respond to changing health needs (Ono, Lafortune and Schoenstein, 2013[80]).

Throughout this report, it has been emphasised that digital transformation in the health sector is much more than a simple technical change of going paperless, linking the existing databases, or digitalising existing tasks. Digital transformation means that the various digital technologies are leveraged to design more appropriate, effective, and efficient models of care. The examples of such new digitally-enabled care models discussed in this report involve shifting services from the hospital sector to primary or home care and between different categories of health professionals. The new care models allow also for increased flexibility and responsiveness of the services, changing when, where, and how patients interact with health professionals and helping to move away from reactive towards proactive approaches to preserving health. The digitally-enabled care models can also help to increase the patients' involvement in the care process and develop their self-care skills, opening opportunities for more effective co-production of health between patients and health workers. All these changes in health services delivery are expected to influence the health outcomes and consequently the future demand for health services and the corresponding future demand for various categories of health professionals.

Hence, a successful digital transformation requires also that health workforce planning takes into account the future digitally-enabled care models. It means that health workforce planning methodologies cannot rely exclusively on the traditionally used quantitative information on past health services utilisation and supply of health professionals but need to additionally include qualitative intelligence. Such qualitative intelligence includes scenarios describing how future care models are to be configured as well as informed assumptions about the changes in health care provision needs of the population under these new models of care. This requires plausible outlooks about the future direction and magnitude of reforms as well as incorporating a wide range of information, including estimates by expert groups. Such information necessarily has different levels of precision and hence, the outputs of such models need to be seen as 'plausible futures' rather than as firm predictions.

In general, introducing qualitative intelligence into health workforce planning is complex and its use is limited across the EU and OECD countries. The most frequently used models extrapolate forward demand only for a single category of health workers in relation to the existing health services configuration. In a few countries, health workforce planning models incorporate the potential impact of certain changes in health service delivery on health workforce demand, but these changes are not directly linked to the adoption of digital health technologies. In the Netherlands, for example, the model for health workforce planning in general practice regularly assesses the possible scope for task substitution between general practitioners (GPs) and nurses as a possible option to reduce the expected growth rate of demand for GPs.

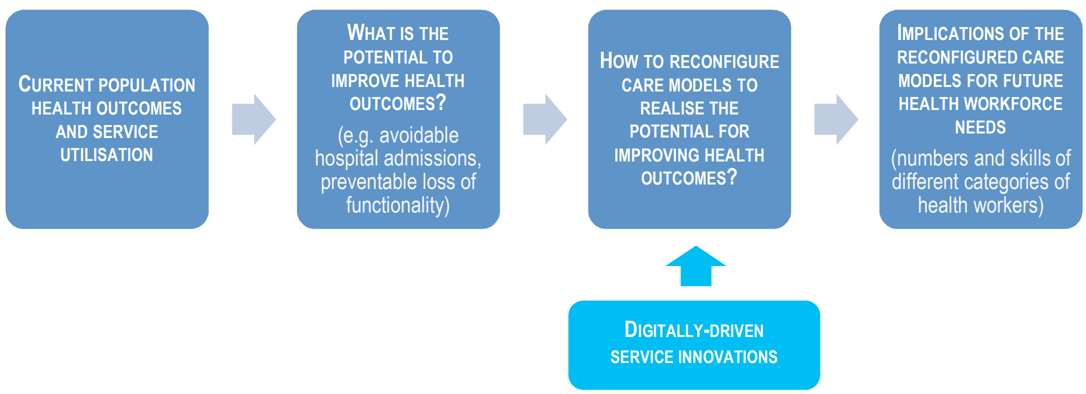
A particular approach to incorporating qualitative intelligence has been adopted by Health Workforce New Zealand (HWNZ) - a government agency charged with providing national leadership for the development of New Zealand's health workforce. Over the last decade, HWNZ embarked on a comprehensive programme of Health Service Reviews, which aim to understand the workload that results from the interplay between health needs of a given population group and different health services configurations. The programme aims to help reconcile the expected substantial increase in demand for health services (due to ageing population and increasing burden of chronic conditions) with the potential shortages of health professionals (due to limited increase in funding, among other factors) (Rees, 2019[81]).

The point of departure for the reviews undertaken by the HWNZ are current health outcomes and health service utilisation of a given population group, such as the elderly or patients with diabetes, coupled with investigation about the scope for improving these health outcomes. The next step is considering how the existing care models should be reconfigured to realise the potential for improving health outcomes and how such a reconfiguration impacts the future health services utilisation. The reviews result in a Work Service Forecast for a particular service aggregate, which include a proposal for service configuration and consider what changes need to happen in relation to the health workforce development, in terms of both the numbers and skills of different categories of workers (Figure 3.3 and Box 3.7). These re-configured models of care combine digitally-driven service innovations with other changes, such as task-shifting between different categories of health workers or changing of the setting where care is provided, e.g. from hospital to primary-care sector.

The reviews are undertaken by interprofessional teams of experts and rely on a wide range of information derived from, for example, available statistics, reviews of academic literature, or field expert estimates. While the reviews are carried out separately for each particular service aggregate, such as care for the elderly, HWNZ recognises that any innovation in a particular service aggregate will need to be complementary to the existing services and other innovations to create and maintain a system of well-integrated health services (Rees, 2019[81]).

Figure 3.3. Health Services Reviews methodology – Health Workforce New Zealand

From population health needs to future health workforce needs



Box 3.7. Work Service Forecasts for elderly care and diabetes care - Health Workforce New Zealand

Future elderly care model and workforce

The HWNZ service review and workforce forecast for elderly care considers the evidence that among the elderly the biggest driver of demand for health services is the level of functional impairment. The key point is that in any projection of health service utilisation the main drivers will not only be the numbers of people over the age of 65 but also the levels of functional impairment within that population. The forecast considers also the experts' view that the rate at which older people develop severe functional impairment is a modifiable risk factor. Specifically, it assumes that there is a potential for a 30% decrease in the rate at which those with some functional impairment develop severe functional impairment as well as for a 30% increase in the rate at which those who suffer from functional impairment recover some or all of their functioning. Functional impairment thus becomes a point of intervention for affecting the future utilisation of health services by the elderly.

Based on the above, the review considers how care models need to change in order to reduce the rates of functional impairment among the elderly, thereby impacting the future service demand and workforce needs. A major service shift put forward is to enhance preventive and restorative care provided within community and home-care setting, by leveraging digital technologies and (re)training the community and home-care workers in rehabilitation skills, among other changes. The key guiding principles for such a service reconfiguration include:

- supporting people in their homes where possible through, for example, supporting self-care, where assisted-living technologies offer a range of opportunities (see Box 1.7);
- avoiding the disruption of older people's normal routines and self-management by bringing services to people rather than moving people to the service;
- more active and rapid rehabilitation.

The simulation exploring the impact of the reconfigured care model suggests that over 10 to 15 years, the expected increase (under an unchanged care model) in admissions to residential care or acute hospital admissions among elderly could be reduced by around 15% and 30%, respectively. These projections also assume that it would take 5 years to fully implement the changes. The simulation of the impact upon workforce requirements indicates that the expected increase (under an unchanged care model) in number of nurses required in aged residential care would be reduced by around 30% over 15 years. There would also be a commensurate decrease (of around 8%) in the demand for additional geriatricians working in hospitals.

Future diabetes care model and workforce

Recognising the growing burden of diabetes, the service review and workforce forecast for the diabetes care considers evidence on potential for improving health outcomes of people living with diabetes, especially the scope for preventing and delaying type-2 diabetes and its complications.

The review proposes that under new care models focusing on prevention, self-management skills, and co-ordination of interventions, the burden of diabetes could be reduced over a period of 15 years, instead of the projected annual increase in incidence at a rate of 9% (under an unchanged model of care). This would mitigate the significant expected growth in demand for primary-care workforce. The proposed new care model relies on the adoption of a wide range of digital tools and solutions. The key changes include the widespread use of:

- digital tools and solutions supporting the development of self-care skills of people with diabetes and facilitating their participation in the care process
- interoperable information systems providing decision-making support, aiding clinicians in the delivery of co-ordinated services, and reducing duplication of interventions and administrative tasks
- telehealth services

Source: (HWNZ, 2011[82]; HWNZ, 2011[83])

Digital technologies and automation in health care

In the broader economy, the impact of digitally-driven innovations is frequently discussed in terms of the potential for automation, i.e. the transfer of tasks or jobs from people to machines. The health-care workforce, however, comprises a high proportion of professional jobs the execution of which requires complex human interactions. Compared to the entire labour market, health sector jobs are therefore among the least likely to be automated according to the latest estimates by the OECD (Nedelkoska and Quintini, 2018[84]). This is due to the so-called bottlenecks to automation – i.e. the tasks that, given the current state of knowledge, are difficult to automate. These tasks require, for example, social intelligence, such as the ability to effectively negotiate complex social relationships, including caring for and assisting others and recognizing cultural or situational sensitivities. They also require the ability to carry out physical tasks in an unstructured work environment. These task are abundant in the daily work performed by front-line health workers, from hospital-based physicians to home-care providers.

As discussed in Chapter 1, machines are likely to complement – rather than replace - health workers in tasks that are easy to standardise, repetitive, and heavy on data processing, such as selecting irregular results from large volumes of preventive or routine chronic care tests, synthesising information relevant for a given patient's condition from numerous sources (patient records, archives, guidelines, specialist recommendations), or analysing patterns in patient outcomes for predicting behaviour (for example, no-shows), and informing regular improvements in practice (see also Box 1.8 in Chapter 1). In short, in the health sector the augmentation of human labour is more likely than its automation (OECD, 2019[26]).

However, the evidence for the impact of digital technologies on health workers' productivity is still limited. The use of AI, for instance, is only emerging in some areas of health care, with most of the applications being still in the research and development stage (see Section 3 in Chapter 1). There are some promising signals, for example within the field of assisted-living technologies - the evidence on the impact of some digital solutions, such as digital incontinence care, suggest that long-term care workers could become more productive in performing selected tasks (see also Box 1.7 in Chapter 1).

In order to secure progress in the field, governments and other funders should invest in demonstration projects of promising digitally-enabled care models or care routines, to gather evidence and ensure that innovations that do demonstrate value become new standards of care. Such models of care can subsequently form the basis for health workforce planning.

Nevertheless, automated systems alone cannot achieve the change required to effectively address the growing demand for health workers. As illustrated throughout this section, this will require multiple and well-orchestrated initiatives that allow for the adoption of more appropriate, effective, and efficient models of care. Moreover, these will need to be supported particularly by appropriately reformed funding mechanisms.

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