4 Engaging and transforming the health workforce

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Digital transformation, which includes the generation of electronic health data as well as its appropriate use, bears the promise to help address the increasing demand for health services by improving the effectiveness and productivity of health service delivery. This chapter discusses how the health workforce matters for a successful implementation of digital technologies in general and for making the best use of data collected across a health system in particular. It also discusses how the deployment of various digital innovations can affect the health professionals, for example, in terms of their roles and the way their daily tasks are carried out. The chapter describes also the skills needed to best put health data to work as well as examples of national approaches to ensure an adequate supply of these skills, to appropriately engage health workers, and build their trust in the digital technologies.

4.1. Introduction

One of every ten jobs in OECD countries is in health and social care, placing the sector among the largest employers. Productivity improvements have been hard to achieve in this sector but are increasingly needed in the face of evolving health needs on the one hand and limited resources on the other. Digitalisation in general – which includes the generation of electronic health data as well as its appropriate use – bears the promise to help address the increasing demand for health services by improving the effectiveness and productivity of health service delivery.

So far, in the majority of the OECD countries, the most prevalent instance of the use of information technology in the health sector has been the introduction of electronic health records (EHRs), although their implementation has not always been entirely successful. More recently, in some countries, the health sector has started to make use of digital technology to analyse the data generated in the sector to, for example, better adapt services to the people's health needs and preferences, to improve patient involvement, as well as to advance the communication and cooperation among health professionals to better integrate care.[1]

Emerging digital tools based on Big Data and developments in artificial intelligence (AI) – notably, deep learning – also offer a promise of customised decision support for clinicians and creating "learning health systems", in which knowledge contained in the diagnoses and decisions made by nearly all clinicians and the respective patient outcomes inform the care of each individual patient.

This strategic orientation to harness health data requires not only investing in the infrastructure and interoperability, but also the sustained engagement of health workers, who as front-line users of the technology need support in building the capacity to put it to work effectively and safely. Far too often, however, the potential benefits of digital technologies cannot be fully realised because health professionals are not adequately skilled for using them, or the day-to-day work processes are not adequately re-engineered to enable the technology to add value. Moreover, health workers are rarely involved in the development of digital tools meant to assist them, which frequently results in a suboptimal design that does not address their (and their patients') needs adequately. All of this reveals a troubling picture of health workers facing a serious misalignment of skills or jobs and tools at their disposal, which is not only likely to result in inefficiency and waste, but also places undue burden and strain on the workers.

Furthermore, the stakes are decisively higher when a decision or recommendation provided by automated systems affects health outcomes rather than travel arrangements, the shipping of products, or the selection of a car insurance policy. While data-driven digital innovations continue to be designed in order to change the practice of health care, the existing professional and ethical frameworks do not necessarily account for these developments. As a result, health workers face unanswered questions of ethical and legal nature, for example, about their and the automated systems' respective roles, how to ensure that automated systems do not crowd out patient-provider shared decision making, or about the implications for accountability of actions based on AI-produced information.

Against this background, this chapter discusses how the health workforce matters for a successful implementation of digital technologies in general and for making the best use of data collected across a health system in particular. It also discusses how the deployment of various digital innovations can affect the health professionals, for example, in terms of their roles and the way their daily tasks are carried out. The chapter describes also the skills needed to best put health data to work as well as examples of national approaches to ensure an adequate supply of these skills, to appropriately engage health workers, and build their trust in the digital technologies.

4.2. Together, humans and machines can generate better health outcomes than either could alone

The range and volume of data – including clinical, genetic, behavioural, and environmental data – collected within health systems is growing rapidly, in part because much of it is produced directly in digital form. Every day, health professionals, biomedical researchers, and patients produce vast amounts of digital data through the use of, for example, EHRs, genome sequencing machines, high-resolution medical imaging, smartphone applications, and Internet-of-Things (IoT) devices that monitor individuals' health (OECD, 2015[1]).

As discussed in Chapter 2, solutions harnessing health data and digital technologies – such as data-driven risk-stratification models, clinical decision aids, tele-monitoring of the patients' health, or technology-assisted provider networks and communications infrastructures – provide an opportunity to improve the access, effectiveness, and productivity in health services delivery. If leveraged adequately, data available within health systems help, for example, to reduce errors, to improve the co-ordination of care, or to better identify specific health needs of individuals and population groups. It can enhance the precision in targeting preventive interventions at the persons most likely to benefit from them, while avoiding treating others unnecessarily, and provide tailored care pathways to the growing number of people living with chronic conditions, thus reducing the risk of hospital (re)admissions (see Chapter 2 for further discussion).

Moreover, emerging digital tools based on Big Data analytics and the recent developments in AI – notably, deep learning – allow machines to perform cognition(-like) functions. For many jobs, these developments fuelled the question: "*Can the tasks of this job be sufficiently specified, conditional on the availability of big data, to be performed by state of the art computer-controlled equipment?*" (Frey and Osborne, 2017[2]). OECD expects that the technology is likely to affect nearly half of all jobs in terms of their task composition, with one in seven jobs having high probability of being entirely restructured in terms of job tasks or significantly downsized (Nedelkoska and Quintini, 2018[3]). These estimates refer to technological possibilities, abstracting from the speed of diffusion and likelihood of adoption of such technologies.

4.2.1. Most health sector jobs will remain, but some specific tasks will become automated, freeing up time for more complex activities

The health-sector workforce comprises a high proportion of professional jobs. The execution of these jobs requires complex human interactions, similar to the jobs in education, for example. 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[3]) (Figure 4.1).[2]

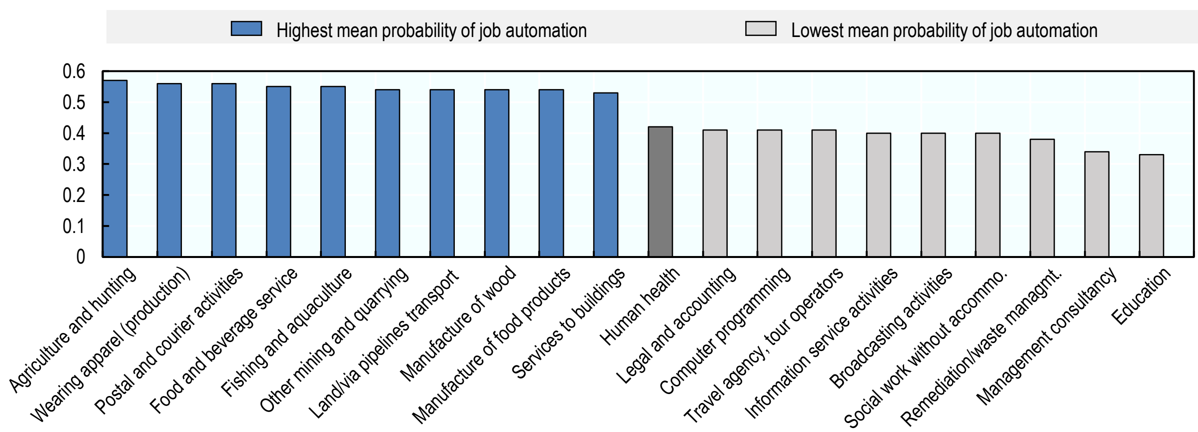
However, many health workers could see a significant change in the way their jobs are carried out. Machines are likely to complement health workers in tasks that are repetitive, time-consuming, and heavy on data processing, such as selecting irregular results from large volumes of preventive or routine 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. In short, in the health sector the augmentation of human labour is more likely than its automation (Davenport and Glover, 2018[4]; Health Education England, 2019a[5]; Nedelkoska and Quintini, 2018[3]; Confédération suisse, 2017[6]) – (Box 4.1).

The resulting gains in productivity and effectiveness could make it possible to redirect staff to address service bottlenecks; to allow greater interaction with the patients to address their needs more effectively, efficiently, and equitably; as well as to provide time for engaging in value-added tasks that require critical thinking and creativity, such as quality improvement.

However, in order to take advantage of these opportunities, the health workers must trust and be equipped with the mindset and skills to use digital tools effectively and safely. Realising the full potential of health data and digital technologies requires also more health data scientists, more technologists with an understanding of the health sector, and more clinical leaders with an understanding of technology to ensure the right combination of digital skills, an ability to improve processes, and an ability to design solutions that truly benefit patients and health workers.

Figure 4.1. Health jobs are among the least likely to be automated

Jobs most and least likely to be automated, 20 industries



Notes: Not all tasks related to caring for and assisting patients that cannot be automated could be included in the calculation; hence, estimates for the health sector are biased upwards. High mean probability of job automation means that the mean job in a given industry is highly automatable based on tasks it involves. Low mean probability of job automation indicates that the mean job in a given industry might change with regards to how some of its tasks are carried out.
Source: OECD (2018) "Automation, skills use and training", Paris, https://doi.org/10.1787/2e2f4eea-en; OECD Survey of Adult Skills (PIAAC) 2012, 2015.

Box 4.1. Augmentation of human labour is more likely than automation – the case of radiology

Since many decades, making use of the steady increase in available computing power together with qualitative developments in digital technologies continues augmenting profoundly the work of health care professionals.

Take X-ray imaging, for the sake of concreteness. It and its medical use started out at the end of the 19th century, taking two-dimensional analogue pictures. Today, digital sensors akin to the CCD chips that took the place of the film in digital cameras produce radiographs directly in digital form; apart from permitting for a dose reduction benefitting the patient, this admits the direct use of image enhancing techniques and fast, lossless duplication and transfer.

Next, the rise in computing power made possible the necessary computations for reconstructing three-dimensional (tomographic) images – also used in MRI, which does not use ionising radiation. Today, contingent on the ever increasing locally available computing power, medical images can be taken in four-dimensions, i.e. processes and movements can be followed over time. The automatic differentiation of tissue types and many other image processing techniques are commercially available features.

Alongside this technical progress the medical specialisation of radiologist developed, who specialises in understanding medical imagery (particularly also the limitations) and in interpreting it. Radiology is a growing branch of medicine in the number of images taken, in revenue, and in people employed. In fact, in many countries there is a shortage of radiologists. For instance, a number of OECD countries expect most profound capacity challenges in the radiology workforce as many consultant posts remain unfilled (The Lancet, 2016[7]). This is in spite of the fact that there are plenty of medical doctors who combine another specialisation, e.g. as surgeon, orthopaedician, or gynaecologist, with a specialisation in radiology. These shortages will exacerbate in an aging population.

The increase in computer power also made it feasible to analyse large datasets containing medical imagery using artificial intelligence (AI), especially deep learning. AI had some astounding successes, outperforming humans and non-AI computerised data analyses in pattern recognition, data segmentation, image classification, and other tasks – outside and within medicine research – but it is really not understood why. Neither is it understood why AI sometimes fails spectacularly when facing setting modifications that are irrelevant for a human observer. Generally, computers need 'kind' – as opposed to 'wicked' – learning environments (Hogarth, Lejarraga and Soyer, 2015[8]) to succeed. In a 'kind' learning environment accurate inference is made possible by a close and accurate feedback on predictions (or actions taken in general) 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 learning requires much larger training datasets, but might become altogether impossible in the presence of biases. Medicine is by default poised by 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, blindly relying on AI outputs in the vital setting of the health care sector is not an option, at least not for some time to come.

The aforesaid recommends such computer algorithms for well defined – i.e. 'kind' – sub-problems involving the processing of big amounts of data as input to a human-led medical examination and to a – thus better informed – human-led decision making. In medicine this person will be a highly trained professional, who, additionally, learned how to make the most of the strength of the computer and who will be needed to train the computer initially as well as repeatedly if there occur changes in data acquisition – for example, when improved equipment becomes available – or reference standards – for example, due to progress in medical research. A captivating example outside the health-sector context for the achievement potential of such human-computer tandems is Advanced Chess, where unranked human chess players in cooperation with strong PCs can outperform grand masters and supercomputers (Epstein, 2019[9]).

It follows that the need for large training datasets bars computers from permeating areas with sparse data. For example, for relatively rare patients like those in the highest age groups or rare diseases large enough datasets will never exist; but 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 – combining concepts from different scientific fields (e.g., anatomy, physiology, or medical physics) – even on small samples.

As an aside, all of the above makes speculating about the demise of the radiologist due to the advent of AI – as has happened in the media – appear exaggerated, even in the unrealistically narrowed down sense of a pure diagnostician, which denies them their roles as, inter alia, therapists and researchers. In addition, their expertise will be needed for continued development and refinement of AI in this field.

Finally, the models of health service delivery are continuously changing in attempts to increase the efficiency and effectiveness of care. This potential for improvement means that as routine and repetitive tasks are automated humans can dedicate more time to non-standard tasks requiring critical thinking, adaptive problem solving, and creativity. Even the much less complex technology – such as automated drug dispensing in hospitals – have not led to the demise of hospital pharmacists. Rather, the technology opened the opportunity for pharmacists to engage in, for example, strategic procurement of hospital pharmaceuticals – a function which was previously performed like an administrative task by personnel without pharmaceutical expertise or insights into patient care. The latter are crucial for the transition to strategic value-based procurement, though.

4.3. Engaging and transforming the health workforce is essential

Starting in the 1950s, multiple industries – financial services, retail, entertainment, and others – have invested in digitalisation and leveraging digital data with the aim to transform and improve their business models. While ultimately successful, these industries experienced a number of intermediate failures. Each of these failures has its own particulars, but all share certain overarching characteristics:

- the failure to engage and gain the buy-in of end users of the new systems;
- the failure to invest in adopting the skill mix of the end users of the new systems, or to create new roles for individuals with the appropriate skills to manage the change;
- the failure to appreciate the changes to the nature of the work, the tasks to be done, and who does them (The National Advisory Group on Health Information Technology in England, 2016[10]).

In the labour intensive health sector, any effort to improve the service delivery through digitalisation and the use of digital data also requires the initial and sustained engagement of the people doing the work. Moreover, there is a need to ensure that health workers are adequately supported through education and training to effectively and safely adopt the new and emerging digital work tools. Without the right people and skills, digitisation will fail, or at least not achieve its full potential. Finally, in order to avoid simply digitising ineffective and inefficient analogue processes, digitisation needs to be accompanied by rethinking the work processes; in particular, the affected tasks should be reimagined for a digital environment.

4.3.1. Adoption of digital data systems shifts the mix of skills required in health-sector jobs

As automation and digital technologies integrate into health services, the mix of skills required in health-sector jobs shifts. Some OECD countries – for example, Australia, Norway, Switzerland, New Zealand, and the United Kingdom – completed a review or established a regular process to assess how technological and other developments (for example, IT, AI, genomics, or demographics) are likely to change the skill requirements as well as the roles and functions of health workers over the next one to two decades, including the consequences for the education of future and the training of current health workers. A similar review is underway in Canada, with results to be published in 2020.

In general, the successful implementation requires

- a (larger) cadre of **clinician-leaders in digital and information technology** with a combined understanding of clinical practice, technology, and change management. These individuals are needed to ensure that digital solutions do work for the benefit of patients and the front-line health workers as well as to serve as crucial bridges between the technology and the front-line staff.
- **clinician and non-clinician informatics professionals**, researchers, programme evaluators, and system optimisers with expertise in clinical informatics. Among other skills, such individuals must possess a strong understanding of user-centred design principles and understand the critical role of patients and workers in adopting innovation throughout health and social care organisations.
- every front-line clinician to possess a **foundational level of digital skills** such as a basic understanding of how the data employed by digital tools is collected, analysed, and how the algorithms powering the digital tools use the data to produce information. These skills should not be tied to any specific technology but allow every clinician to exploit digital tools and data to improve care and fully partner with patients, as well as help them understand and tackle the underlying biases and challenges in the data.

A clinician-leader in information technology (often referred to as chief clinical information officer) is an emerging role in health systems globally. While responsibilities of the role and the scope of practice vary across health systems, a clinician-leader in IT requires competencies in both information technology and leadership, but first and foremost they must be clinical professionals with front line experience of patient care. Their clinical background may be medicine, nursing, or pharmacy, depending on the needs. A cadre of clinician-leaders in IT is essential to ensure the new technology addresses the needs of patients and health professionals, to build trust in technologies among and engage with the wider health workforce, and to manage the culture change needed to drive learning across organisations (The National Advisory Group on Health Information Technology in England, 2016[10]; Sood and Keogh, 2017[11]).

The clinician-leaders in IT will need to be supported by teams of both clinician and non-clinician informaticians as well as researchers, programme evaluators, and system optimisers with expertise in clinical informatics. These people shape the information that is communicated to and used by the front-line health workers; hence, they should possess a strong understanding of user-centred design, among other skills (The National Advisory Group on Health Information Technology in England, 2016[10]).

Most importantly, the majority of front-line health workers, clinicians in particular, will require some element of digital skills to effectively and safely navigate a data-rich health care environment. The skills requirements might vary depending on their respective role and/or specialty, but a basic understanding of how the data employed by digital tools is collected, analysed, and used to produce information will be most essential, among other things, for the critical appraisal and interpretation of the information as well as for providing patients with an explanation of the information or outcome produced by an automated system. Furthermore, health workers will require training in the ethics of autonomous systems/tools and AI to be able to address any related ethical or patient safety considerations.

As the adoption of digital tools aims to support the transition towards value-based and personalised models of care, the investment in developing digital skills needs to be complemented by strengthening the skills in person-centred communication and patient-provider shared decision making. A successful transition towards value-based and personalised models of care will require that care and treatment decisions become a collaborative process between a person who seeks help (or their family and/or carers) and the providers, taking into account the best scientific evidence available as well as the person’s individual and social context, values, goals, and preferences (Kon et al., 2016[12]). This necessitates, for example, understanding what really matters to patients in terms of health outcomes. Therefore, effective people-centred – as opposed to disease-centred – communication on the part of the health professionals, together with the ability to engage a person who seeks care through shared decision making, are crucial.

In the context of people-centred care, socio-cultural competencies also matter, as they are essential for an effective communication between people belonging to different social, cultural, or age groups. Moreover, shifting the focus from a disease to a whole-person and ensuring the delivery of seamless care requires strong socio-emotional skills to work collaboratively and flexibly across disciplines and provider organisations (OECD, 2018[13]).

4.3.2. The necessary skills needed are often in short supply

As mentioned earlier, complementary investment in workers’ skills and work-processes redesign are needed to successfully deploy technology and deliver promised gains in productivity and performance. There is, however, growing evidence of skills shortages, including digital skills, among health workers. An OECD study (2016[14]) reported on the results from the 2011/2012 OECD Programme for the International Assessment of Adult Competencies (PIAAC), which revealed the overall extent of the skills mismatch among nurses and doctors in OECD countries; in particular 51% of doctors and 46% of nurses reported under-skilling for their daily jobs. While this international study does not contain information on in which of their day-to-day tasks doctors and nurses feel sub-optimally prepared, numerous other publications provide indications of digital skills shortages among front-line health professionals (OECD, 2018[13]; The Lancet Global Health Commission, 2018[15]; Swiss eHealth Forums, 2017[16]).

Digital technology has already changed the way that health care professionals 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[17]) 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[18]).

Depending on the concrete study perused 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 (Hegney et al., 2007[19]; Foster and Bryce, 2009[20]; Skills for Health, 2012[21]; European Commission, 2013[22]; European Health Parliament, 2016[23]; Quaglio et al., 2016[24]; Melchiorre et al., 2018[25]). However, these studies are based on small samples of health professionals and/or focus on narrowly defined skills, such as the ability to operate a digital tool, while the ability to understand and tackle inherent data limitations or risks such as automation bias (favouring suggestions made by automated systems and ignoring other sources of information) remain largely unassessed.

Need for tailored training curricula and leadership

The shortage of digital skills is also reflected in the 2019 Manifesto of the European Medical Students Association (EMSA), in which medical students have called for actions to be taken by European Institutions after the 2019 European Parliament elections to tackle Europe's health challenges. Among the six priority calls for action, EMSA has included a call to put training and education in digital health on the policy agenda and enhance the awareness and trust in digital technologies. More specifically, EMSA calls for the inclusion of educational formats on digital health in medical curricula and for the creation of platforms for faculties to exchange information about best practices in digital health education (EMSA, 2019[26]). While digital health might feature in health professional education programmes and training, it is not always taught at a high enough level as revealed by the gap analysis undertaken within the 2016-2018 *EU-US eHealth Work Project*, which has had the overall goal of mapping, quantifying, and projecting the need, supply and demand for digital workforce skills and competences in the European Union (EU) countries, United States, as well as a number of developing countries (EU*US eHealth Work Project, 2019[27]).

Furthermore, in most OECD countries, health systems lack clinician-leaders with the necessary skills in health care improvement and the redesign of care enabled by digital technologies (The National Advisory Group on Health Information Technology in England, 2016[10]). There is also evidence of a deficit of both clinician and non-clinician informatics professionals (Burning Glass - Career in Focus, 2014[28]; The National Advisory Group on Health Information Technology in England, 2016[10]). In the United Kingdom, for example, the chief clinical information officers (CCIO) Network undertook a survey of its members in 2016, in which 76% of respondents disagreed or strongly disagreed with the statement, "*We have enough trained clinicians in health IT and informatics to maximise the potential of our systems*" (The National Advisory Group on Health Information Technology in England, 2016[10]). In the United States, there are reports of shortages of health informatics workers who can meet the modern requirements of managing medical information – the new and emerging health informatics positions (such as Clinical Analyst) stay open twice as long as the ones they are replacing (such as Medical Records Clerks) (Burning Glass - Career in Focus, 2014[28]).

One possible explanation is that technology is changing the field very rapidly; hence, some of these hard-to-fill positions are examples of jobs recently created by new technology. Another contributing factor is, however, that many of these new jobs are hybrids, requiring skill sets from different disciplines, such as nursing and IT, which are not typically taught together (Burning Glass - Career in Focus, 2014[28]).

Skills supply and demand need to be considered simultaneously

Without the availability of full-time jobs with a sustainable career track, few talented individuals will choose to leave the practice of clinical medicine, nursing, or pharmacy to obtain additional training and certification in health information technology. Similarly, even if suitable education programmes combining knowledge of clinical practice with IT expertise are offered, few students will choose this hybrid path as a career choice when these jobs are not recognised as central to health service delivery, and hence, the corresponding positions are in shortage although they would be needed for a functioning health system (Health Education England, 2019a[5]; The National Advisory Group on Health Information Technology in England, 2016[10]).

4.3.3. Technology must not ‘get in the way’ of work

In the majority of the OECD countries, the introduction of EHRs has been the most significant manifestation of digital technology in the health sector over the past two decades. However, EHR implementation has not always been entirely successful. While these initiatives helped create an important and powerful infrastructure, they have not always been fully informed by, and designed with the needs of patients and health professionals in mind.

A widely held criticism of many EHR platforms is their relative inattention to basic principles of user-centred design (usability), particularly when judged against the electronic tools commonly used in the general population. In the health sector, usability is the extent to which the technology can be used efficiently, effectively, and satisfactorily based on system design, as well as how it is customised in a given work environment to the specific workflows that health professionals employ (International Organization for Standardization, 2010[29]).

Indeed, in some countries, EHRs were designed to address billing and financial functions at least as much as, if not more, than the clinical needs of patients and clinicians (Watcher, 2015[30]). 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[10]). An international review of literature on electronic-medical-record (EMR) and related electronic-health-record (EHR) interface usability issues revealed EMR and EHR usability to be hampered by, for example, problems with control consistency, effective use of language, effective information presentation, and customisation principles; as well as a lack of error prevention, minimisation of cognitive load (alert fatigue), and feedback (Zahabi, Kaber and Swangnetr, 2015[31]). A recent US study reveals other problems caused by EHRs, such as medication errors in the form of improper dosing, prescribing/dispensing the wrong drug, or an in principle correct drug at the wrong time (Ratwani et al., 2018[32]).

Moreover, in the United States, a study commissioned by the American Medical Association found that many doctors cited EHRs as a major source of burnout (Friedberg et al., 2013[33]). The problem lies partly in their poor design, and partly in the fact that EHRs have become enablers for third parties who wish to ask doctors and nurses to document additional pieces of information (for billing, quality measurement, etc.), which turns clinicians into ”expensive data entry clerks”. One sign of this documentation burden is the significant growth in the number of individuals hired to provide real-time EHR documentation – the so-called scribes –, allowing physicians to devote more time again to providing care to their patients, but still incurring additional costs on the health system (The National Advisory Group on Health Information Technology in England, 2016[10]).

People-centeredness is important in the design and implementation of digital technology

To avoid technology getting in the way of work, digitisation needs to be perceived as an essential tool for meeting the needs of patients, their families, and health professionals. To avoid the implementation of systems that can create opportunities for errors and can result in frustrated health professionals and patients, health IT systems must be designed with the input of end-users, employing basic principles of user-centred design (see also Box 4.6 below). Also, the digitalisation efforts should not simply digitise the existing analog processes, which might be less effective and/or efficient (The National Advisory Group on Health Information Technology in England, 2016[10]).

Furthermore, given the relative ease with which yet another and yet another data field can be added in an already existing electronic system, an even bigger conscious effort than in the pre-digital era must be made to ascertain that only such information is collected that is absolutely vital (directly or indirectly) for a patient, so as to not waste time and other resources that could be invested in the patients' health by collecting non-essential data.

Last but not least, the digital data system's implementation itself (plus getting used to employing it) takes a considerable amount of time of almost every front-line health worker in a health system and must be accounted and allowed for. This is also another reason why only thoroughly tested and vetted final versions should be rolled out, as having to deal with and to correct dysfunctional ("beta-")versions and getting used to ever changing new versions wastes huge amounts of work hours which have to be taken away from patient care and which still have to be paid for. In this context, the worst possible outcome could even be – and has been in a number of OECD countries – completely failed implementation attempts, due to insufficient preparation at various levels, which waste(d) resources (Watcher, 2015[30]; The National Advisory Group on Health Information Technology in England, 2016[10]). Notably, the waste of resources reported for known incidences only comprise the direct investment into the data system, not the resources (time) wasted by various actors in the health system during the failed implementation attempt.

4.3.4. Legal and ethical questions must be addressed

The stakes are decisively higher when a digital tool affects clinical outcomes rather than travel arrangements, the shipping of products, or the selection of a car insurance policy. While it is widely recognised that advances in data analytics have and will continue to change the practice of health care, the development of adequate professional and ethical frameworks is lagging behind in most countries.

Professional associations of health workers only recently began to explore legal implications of the use of AI in health care, such as issues of liability or intellectual property, and advocate for appropriate professional and governmental oversight for safe, effective, and equitable use of as well as access to AI related tools (AMA, 2018; CPME, 2019b). In effect, health workers face unanswered questions about their and the machines' roles, about the implications for accountability, or about how to ensure that digital systems do not crowd out patient-provider shared decision making.

It is of utmost importance to ensure not only that digital tools such as AI are evidence-based, trustworthy, and patient-centric, but also that they are respecting core ethical principles (CPME, 2019a).

A key policy challenge is to update professional and ethical frameworks, such that health workers have answers to questions about how to work with machines, AI in particular. Even relatively simple machine-learning models already used – such as those automatically stratifying patients into at-risk and intervention groups – give rise to questions regarding the health workers' and the machines' respective roles, accountability, or, again, about how to ensure that digital systems do not crowd out shared decision-making between patients and providers. For example, questions concern how to communicate to a patient when a risk-prediction model did not recommend a treatment, or what mechanism exists to override the model's recommendation, or what happens if following the model's recommendation leads to a suboptimal outcome (of course bearing in mind that it is unknown whether a better outcome could have been achieved by taking a different course of action).

Health professionals must trust the digital tools at their disposal

Health professionals report that they hesitate using digital tools also due to a lack of insight into their design. The current practice of digital tools being developed with little or no insight and input from health workers must be adapted to ensure that sufficient information on their design and quality of the data used is not only made available by the producers, but that relevant health professionals are involved in the development process. Recent high-profile failures, such as the demonstrably incorrect treatment recommendations produced by IBM's 'Watson' in cancer care due to questionable (but not fully disclosed) data inputs, serve to highlight the challenges. A key problem was that Watson was trained on hypothetical data (as opposed to real-world data), which highlights the importance of strong data governance to ensure transparency and enable putting real-world data to work for productive purposes (see Chapter 8 for further discussion).

4.4. Addressing barriers to health workforce engagement and transformation in the digital era

Addressing the barriers to enable the health workforce to engage with digital transformation and use digital technology to improve their work as well as its outcomes requires action on a range of fronts. Firstly, investments are needed in building trust among health workers – through the adoption of suitable ethical and legal frameworks –, in developing digital skills of front-line health workers, as well as in building a cadre of clinical leaders with expertise in IT and change management. Health-professions education and workforce planning must be addressed to ensure that education and training – with regard to numbers, categories of health workers, and their skills – do not remain static but support strong ties across the education to practice continuum. Moreover, health workers must be actively engaged in the design and implementation of the digital technologies that they are meant to use in order to avoid usability issues and reduce the margin for new type of errors. Finally, the health workers' time needed for the digital data system's implementation itself (plus getting used to employing it) must be accounted and allowed for.

4.4.1. Investing in digital skills of front-line health workers

Higher education institutions and/or professional associations usually lead the transformation of health educational and training curricula in the OECD countries. With regard to digital skills, health education institutions have been expanding the educational content in most OECD countries in the recent years. There has also been a considerable research effort going into the development of digital health competency frameworks to inform the required changes in the education of health workers, in particular nurses and physicians. The largest international project in this field has been the already mentioned 2016-2018 *EU-US eHealth Work Project*, which, among other outputs, produced an international competency framework as well as commensurate educational content for advancing the digital skills of the front-line health workers (EU*US eHealth Work Project, 2019[27]).

Nevertheless, the progress in the adoption of the new digital health education content has been slow, as evidenced by, for example, the recent call for inclusion of educational formats on digital health in medical curricula by the European Association of Medical Students (EMSA, 2019[26]).

Over the last five years, a number of OECD countries – Australia, Canada, Norway, New Zealand, Switzerland, and United Kingdom – undertook expert consultations to establish how technological innovations are likely to change the skill requirements, with the view to inform the transformation of educational and training curricula in digital health. In the United Kingdom, for example, the NHS, on behalf of the Secretary of State for Health and Social Care, established an independent inter-disciplinary expert consultation group, which over 2017-19 worked on describing emerging skills needs as well as roles and functions of health workers, including the consequences for the education of future and the training of current health workers. The report issued in early 2019 (referred to as the *Topol Review*) formulated a set of general recommendations for educators, professional and regulatory bodies, as well as the NHS (Health Education England, 2019a[5]) – (Box 4.2).

Box 4.2. United Kingdom – Educational recommendations for educators, employers, and professional bodies to support a digitally enabled health system.

The *Topol Review*

Professional, Statutory, and Regulatory Bodies need to identify the knowledge, skills, professional attributes, and behaviours needed for health care graduates to work in a technologically enabled service, and then work with educators to redesign the curricula for this purpose.

Education providers should ensure genomics, data analytics, and AI are prominent in undergraduate curricula for health care professionals. Future health care professionals also need to understand the possibilities of digital health care technologies and the ethical and patient safety considerations. Education providers must ensure that students gain an appropriate level of digital literacy at the outset of their study for their prospective career pathway. They should offer opportunities for health care students to intercalate in areas such as engineering or computer science, and equally attract graduates in these areas to begin a career in health, to create and implement technological solutions that improve care and productivity in the NHS.

NHS organisations will need to develop an expansive learning environment and flexible ways of working that encourage a culture of innovation and learning. To do this they will need to have a strong workplace learning infrastructure, cultivate a reputation for training and support, develop learning activities which are proactive rather than reactive, and allow staff dedicated time for development and reflection on their learning outside of clinical duties. The NHS and local organisations should support the development of a cadre of educators and trainers who can lead the educational programme to ensure timely upskilling of the workforce. These organisations also need to put in place systems to identify and develop talented, inspiring new educators within the workforce.

The specialist workforce and specialist teams will be working at the very forefront of their disciplines, often being early adopters of new technologies. Supporting these individuals and teams will be important for continued innovation. In order to support specialists and specialist teams in genomics, digital medicine, AI, and robotics the NHS should develop or expand both educational programmes (for example, the Higher Specialist Scientist Training) and attractive career pathways for both existing and new roles addressing skills gaps in clinical bioinformatics, digital technologies, AI, and robotics. Flexible and responsive training for specialist roles should be introduced. This may include engaging with industrial learning organisations and developing placements, exchanges, and secondments. The NHS should also work with Professional, Statutory, and Regulatory Bodies to introduce and strengthen the accreditation of newer specialist groups.

Source: Health Education England (2019a[5]) "Preparing the health workforce to deliver the digital future", https://topol.hee.nhs.uk/wp-content/uploads/HEE-Topol-Review-2019.pdf.

Some countries have introduced guidelines on integrating digital technology in education and training

Governments in some of these countries also lead initiatives that either issue concrete guidelines on how to integrate digital health topics into health workers education and training programmes or support the development of networks within which educational institutions and other actors – usually professional associations and/or health sector employers – can pool their expertise and resources in the modernisation of the educational and training curricula.

In the "Swiss eHealth Strategy 2.0", for example, empowering the health workers to know and efficiently use ICT tools is a declared field of action with several goals. Accordingly, in 2017, eHealth Swiss – the Swiss Competence and Coordination Centre of the Confederation and the Cantons – has published guidelines for educators on how to integrate eHealth topics into the education and professional training of health workers (eHealth Suisse, 2017[34]). eHealth Suisse leads also a national coordination group on eHealth education with members including educational institutions along with professional associations and umbrella organisations of the health sector employers.

Similarly, Canada Health Infoway – an independent, not-for-profit organisation, fully funded by the federal government – works collaboratively with the provinces and territories (PTs) to promote the active engagement of health care providers involved in the implementation of digital health systems across Canada. Infoway funds a number of initiatives led by educational and accreditation bodies to help prepare the future health workforce. An example is the Association of Faculties of Medicine of Canada (AFMC) initiative to better prepare medical students to practice in an ICT enabled context. Its work led to the development of the eHealth 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 initiatives aimed at improving the preparedness of nursing and pharmacy graduates to work in a technology enabled environment. In partnership with those organisations (AFMC, AFPC and CASN), Infoway has developed the Digital Health Faculty Associations Content & Training Solutions (FACTS) initiative. The Digital Health FACTS program engages 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.

In other countries, health sector employers strive to partner with local educational institutions to ensure an adequate supply of digitally skilled health professionals. In Australia, for example, Metro South Health –one of Queensland's largest health services by population and employed staff – works together with universities as well as training providers to ensure future employees have the needed knowledge and skills (HealthcareIT, 2019[35]). These efforts regard a wide range of digitally-focused roles within health care, including not only front-line health workers, but also project managers and business analysts with IT skills, an ability to improve processes, and an understanding of how to design solutions for patients as well as clinicians.

Investment in digital health infrastructure needs commensurate investment in health workforce skills

How and whether the recommendations formulated for educators, professional and regulatory bodies, and/or employers will be acted upon remains to be seen. Indeed, in most OECD countries much remains to be done to ensure that the skills health workers need for an effective and safe use of existing and emerging digital technologies are taught routinely.

In the majority of countries, the pace of changes has been particularly slow with regard to Continuous Professional Development (CPD) programmes. Most often, to the health workers, suppliers of the technology provide a one-off training, but these frequently address only basic operational issues and are technology specific. In the public sector, health professionals often lack basic training support as digital systems, such as electronic health records, are being introduced (Aerzte Zeitung, 2019[36]; House of Lords, 2017[37]). In short, investments in rolling out digital health services infrastructure are not always accompanied by the commensurate investments in health workforce training.

As an example of coordinated investments, the Australian Government's Digital Health Agency – responsible for all national digital health services and systems – in addition to rolling out a digital health services infrastructure, also provides on-demand training to health care organisations and developed a range of software demonstrations as well as training platforms for health workers to facilitate self-paced training. Health professionals can, for example, familiarise themselves with the digital health functions in their EHRs software without the need for a real patient (Australian Digital Health Agency, 2019[38]). In the United States, the 2009 HITECH Act – created to motivate the implementation of EHR and supporting technology – funded two distinct health IT workforce training programs – the University-Based Training Program and Community College Consortia Program – which supported training of more than 20 000 working professionals and students between 2010 and 2013 (ONC, 2019[39]).

4.4.2. Investing in clinical IT leaders and a cadre of informaticians with clinical expertise

Programmes and accreditation standards in Health or Clinical Informatics[3] have existed in the majority of the OECD countries for some decades now. First programmes appeared already in 1960s in France, Germany, Belgium, and the Netherlands (Haux, 2010[40]). Frequently, the field has been defined as "the interdisciplinary study of the design, development, adoption and application of IT-based innovations in health care services delivery, management and planning" (National Library of Medicine, 2019[41]). The field has been, however, primarily clerical, including positions predominantly involved with the collection, handling, and processing of health information (usually patient records) for the purpose of accurate billing, and much less often for other purposes, such as quality assurance or an improvement in patient care.

Only more recently, Big Data and a shifting focus on population and patient outcomes have reshaped the field of clinical informatics and resulted in a more diverse set of roles, such as Clinical Analysts or Chief Information Officers, which involve sophisticated, judgment-based work aiming at improving the effectiveness and efficiency of health services delivery. However, as discussed earlier, these developments in the Clinical Informatics programmes seem to lag behind the demand for workers who can meet the modern requirements of managing health information. In Europe, for example, Tallinn University of Technology offers a unique Master's programme in Health Care Technology that combines interdisciplinary knowledge of eHealth technologies, financing and change management in health care, medical imaging and signals, as well as medical law and ethics, among other subjects (Tallinn University of Technology, 2019[42]).

Hybrid skills covering clinical leadership and informatics are needed

Moreover, there seems to be room for improvement in the development of education programmes (as well as of the corresponding jobs with sustained career pathways) that closely tie clinical leadership and IT content to produce more of the hybrid skill combinations that the health sector is demanding. Since 2009, there has been a substantial progress in this area in the United States, where the universities and health care organisations have substantially increased the number of informatics fellowships, expanded their health informatics capability, and substantially increased the number of senior clinical leadership positions in informatics and digital transformation (Kannry et al., 2016[43]).

In the United Kingdom, the launch of the NHS Digital Academy in 2017 (Sood and Keogh, 2017[11]) should help accelerate progress. The NHS Digital Academy has been commissioned by NHS England and is delivered by a partnership of the Imperial College London, the University of Edinburgh, and the Harvard Medical School, with funding of GBP 6 million. The aim is to develop a new cadre of at least 300 IT leaders to support the information and technology transformation of the NHS. The Academy provides a year-long, fully accredited and funded programme (Post-Graduate Diploma in Digital Health Leadership) to upskill NHS managers and lead clinicians (e.g. Chief Information Officers, Chief Clinical Information Officers). 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 (NHS England, 2019[44]; Imperial College London, 2019[45]).

4.4.3. Health education governance and health workforce planning require a new approach

As mentioned earlier, in OECD countries, the content of the education programmes for health professionals and their restructuring is typically influenced by higher education institutions and/or professional associations. However, in some countries, governments have initiated measures to increase the influence of other actors, such as health sector employers.

In 2019, the Norwegian Government has actually established a new governance system for determining learning outcomes in health and social education programmes. A key feature of the new system are education specific program groups consisting of representatives of both the education institutions and the health and social service, which revise as well as, if needed, propose new learning outcomes for each education field. The aim is to ensure that the learning outcomes are updated at regular intervals to reflect any emerging skills needs (Box 4.3).

Box 4.3. Outcome-based national curriculum regulations for Norwegian health and welfare education

The Norwegian government is currently in a process of major restructuring of National Curriculum Regulations in health and welfare education with the aim to make these more future-oriented. The restructuring is based on acknowledging that curricula easily can become too static and fail to adapt to the rapid changes taking place in the related services. New technology, new professional knowledge, changing demographics, and major service delivery reorganisations have shifted the required skill mix. The restructuring is a collaborative effort of the Ministry of Education and Research, the Ministry of Labour and Social Affairs, the Ministry of Children and Families, as well as the Ministry of Health and Care Services.

So far, the restructuring process has led to the adoption of a new National Regulation relating to a common curriculum for health and welfare education that includes 12 learning outcomes common to all study programmes, as well as regulations introducing national (uniform) curricula for each study programme.

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 intention is that the curricula will function dynamically and be amended as needed. 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 to be formulated in accordance with the National Qualifications Framework and define the minimum requirements relating to graduates' final competencies. The curricula are to be phrased on a medium level of detail to allow leeway for possible local adaptations at the higher education institutions. The curricula will be implemented in 2020-21 and must be adhered to by all respective higher education institutions.

At present, the new governance system covers the national curricula leading to the following qualifications: Audiologist, Child welfare officer, Clinical Nutritionist, Dentist, Dental hygienist, Dental technician, General Nurse, Medical Laboratory Technologist, Occupational therapist, Optometrist, Paramedic, Pharmacist (both head pharmacist and dispensing pharmacist), Physiotherapist, Physician, Prosthetist, Psychologist, Radiographer, Social educator, and Social worker. There are also plans for RETHOS to cover specialisation programmes in the near future.

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

Some countries strive also to adopt new tools and techniques in health workforce planning, with the aim of securing not only the right number of existing categories of health workers but also of timely recognising the need for new professional categories/roles and avoiding a mismatch between skills possessed by the health workers and those required in day-to-day practice. These new tools and techniques can be adapted to deliver a workforce with the right skills and career opportunities needed to realise the full potential of digitalisation and electronic health data.

New Zealand's recent workforce policy and planning approach, for example, has adopted new tools and techniques to better identify skills and roles needed for modern and emerging care models. The agency created for this task – Health Workforce New Zealand (HWNZ) – seeks to understand how future services may be configured by applying a method influenced by design thinking to better respond to future health needs (Ministry of Health, 2014[46]; Ministry of Health, 2016[47]; Rees, 2019[48]). This approach extends the conception of health workforce data beyond the traditionally collected quantitative data to recognise qualitative workforce intelligence. It includes, for example, the use of Work Service Forecasts (WSFs), where clinically-led teams describe future scenarios of care. HWNZ has begun to incorporate the results of WSFs into its planning system (Box 4.4). However, the policy challenge HWNZ is now confronted with is aligning the new governance methods with implementation (Rees, 2019[48]).

Box 4.4. Health Workforce New Zealand and its rethinking of workforce policy and planning

Health Workforce New Zealand (HWNZ) – established in late 2009 – is an agency charged with providing national leadership for the development of the country's health and disability workforce and with the overall responsibility for planning and development of the health workforce to ensure that it is fit for purpose (Ministry of Health, 2014[46]; Rees, 2019[48]).

While continuing to use traditional workforce forecasting methods, HWNZ has extended the range of tools that it has at its disposal. Their application has enabled the use of a wider range of planning methods to develop broader workforce intelligence variables. The agency reconsidered how health workforce planning may proceed and sought to understand how future services may be configured to better respond to future health needs (Rees, 2019[48]).

One of the most significant changes that HWNZ implemented was to adopt an approach of workforce planning that embraced conditions of uncertainty and to conceive new visions of health services. Operationalising this approach led to the development of the Work Service Forecast (WSF), a clinician-led and patient-centred scenario, resulting in a forecast of possible future model(s) of care for a particular service aggregate. The process of developing HWNZ's thirteen WSFs from 2010 to 2013 was designed to reduce the system's reliance on profession-by-profession forecasting while accommodating inherent uncertainty and emerging workforce and treatment innovations (Ministry of Health, 2014[46]). The WSF development process uses a wider range of forecasting methods and techniques, such as scenarios, stakeholder workshops, and expert panels, while incorporating broader workforce intelligence variables to generate its demand-supply predictions. The methodology incorporates aspects of design thinking – a planning process that uses reflection and analysis, visualising, modelling, as well as planning to trial – test and implement a solution for a problem (Rees, 2019[48]).

The introduction of the new WSF process met with some resistance, which is, however, not unusual with new planning methods or approaches. Even so, the WSF process was found to have been a successful means for bringing together interdisciplinary groups of professionals, building capacity, and developing new ways of thinking about services and workforce plans (Naccarella, Greenstock and Wraight, 2013[49]).

HWNZ is also introducing more qualitative intelligence through a scope of practice analysis, in particular their scope overlap or plasticity analysis investigates the possible substitution of professionals at some stages of care (Rees, 2019[48]).

4.4.4. Reinforcing health workers' trust and promoting engagement in the development of digital technologies

Trust will play a crucial role in the uptake of digital innovations, AI in particular, in daily health care practice. Both health professionals and patients might need convincing of the reliability and safety of AI and its positive contribution to the care process. A key policy challenge is to timely update professional and ethical frameworks, such that health workers have answers to questions about how to work with machines. Any delay makes health professionals hesitant to use data-enabled digital tools or other technologies that enhance cooperation among providers across settings.

The 2019 OECD Recommendation on Artificial Intelligence can guide countries in this regard (OECD, 2019[50]). The Recommendation recognises that AI has the potential to improve the welfare and well-being of people, to contribute to positive sustainable global economic activity, to increase innovation and productivity, and to help respond to key global challenges. The Recommendation considers, however, that, at the same time, AI may have disparate effects within, and between societies and economies, notably regarding economic shifts, competition, transitions in the labour market, inequalities, as well as implications for democracy and human rights, privacy and data protection, and digital security. The Recommendation therefore stresses that that:

- trust is a key enabler of digital transformation;
- although the nature of future AI applications and their implications may be hard to foresee, the trustworthiness of AI systems is a key factor for the diffusion and adoption of AI;
- a well-informed whole-of-society public debate is necessary for capturing the beneficial potential of the technology, while limiting the risks associated with it.

While the document recognises that certain existing national and international legal, regulatory, and policy frameworks already have relevance to AI – including those related to human rights, consumer and personal data protection, intellectual property rights, responsible business conduct, as well as competition – it also notes that the appropriateness of some frameworks may need to be assessed and new approaches developed. Accordingly, it provides governments with a set of principles for a responsible stewardship of trustworthy AI that include:

1. pursuit of inclusive growth, sustainable development, and well-being;
2. respect of human-centred values and fairness;
3. commitment to transparency and explainability;
4. ensuring of robustness, security, and safety; and
5. accountability for the proper functioning of AI systems (Box 4.5) (OECD, 2019[50]).

Box 4.5. OECD Council's principles for responsible stewardship of trustworthy AI

The following principles are complementary and should be considered as a whole.

Inclusive growth, sustainable development and well-being

- Stakeholders[1] should proactively engage in a responsible stewardship of trustworthy AI in pursuit of beneficial outcomes for people and the planet, such as augmenting human capabilities and enhancing creativity, advancing inclusion of underrepresented populations, reducing economic, social, gender and other inequalities, and protecting natural environments, thus invigorating inclusive growth, sustainable development, as well as well-being.

Human-centred values and fairness

- AI actors[2] should respect the rule of law, human rights, and democratic values, throughout the AI system lifecycle. These include freedom, dignity and autonomy, privacy and data protection, non-discrimination and equality, diversity, fairness, social justice, as well as internationally recognised labour rights.
- To this end, AI actors should implement mechanisms and safeguards, such as the capacity for human determination, that are appropriate to the context and consistent with the state of art.

Transparency and explainability

- AI actors should commit to transparency and responsible disclosure regarding AI systems. To this end, they should provide meaningful information, appropriate to the context, and consistent with the state of art:
    - to foster a general understanding of AI systems,
    - to make stakeholders aware of their interactions with AI systems, including in the workplace,
    - to enable those affected by an AI system to understand the outcome, and,
    - to enable those adversely affected by an AI system to challenge its outcome based on plain and easy-to-understand information on the factors, and the logic that served as the basis for the prediction, recommendation, or decision.

Robustness, security, and safety

- AI systems should be robust, secure, and safe throughout their entire lifecycle such that, in conditions of normal use, foreseeable use or misuse, or other adverse conditions, they function appropriately and do not pose an unreasonable safety risk.
- To this end, AI actors should ensure traceability, including in relation to datasets, processes, and decisions made during the AI system lifecycle, to enable the analysis of the AI system's outcomes and responses to inquiry, appropriate to the context and consistent with the state of art.
- AI actors should, based on their roles, the context, and their ability to act, apply a systematic risk management approach to each phase of the AI system lifecycle on a continuous basis to address risks related to AI systems, including privacy, digital security, safety, and bias.

Accountability

- AI actors should be accountable for the proper functioning of AI systems and for the respect of the above principles, based on their roles, the context, and consistent with the state of art.

1. Stakeholders include all organisations and individuals involved in, or affected by, AI systems, directly or indirectly.
2. AI actors are a subset of stakeholders, i.e. those who play an active role in the AI system lifecycle, including organisations and individuals that deploy or operate AI.
Source: OECD (2019[50]) "Health system accounts", https://stats.oecd.org/.

Digital tools must be designed with the input of end-users

Furthermore, health professionals report their hesitancy in using digital tools also due to a lack of insight into their design and due to the fact that some digital systems and tools simply lack usability. The still prevalent practice of digital tools being developed using hypothetical clinical data and/or with little or no input from health professionals must be adjusted to ensure that sufficient information on their design is not only made available by the producers but that relevant health professionals are involved in the design process.

The experience of other industries illustrates clearly that digital tools must be designed with the input of end-users, employing basic principles of user-centred design (Box 4.6). The usability of technology is one of the major drivers of its widespread adoption and use in everyday life. Usability also affects the quality of the data collected, and is thus a major determinant of the power of analytics (The National Advisory Group on Health Information Technology in England, 2016[10]).

Creating and enacting campaigns to engage front-line health workers should be a fundamental part of the digital transformation in every organisation in the health sector. Health care provider organisations and funders should also consider supporting academic or other partners in research assessing the usability of emerging digital systems and tools using validated assessment methodologies. Such reviews could then factor into decisions regarding purchasing and implementation of the digital systems and tools (The National Advisory Group on Health Information Technology in England, 2016[10]).

Box 4.6. Human-Centred Design and implementation of digital tools in health care

Using human-centred design (HCD) is becoming a trend across industries and organisations, which share the perspective that any effort to improve a system, its processes, or its products and services must begin with customers and the people doing the work.

In the health sector, HCD can help bridge the gap from developing a new idea to broad use by ensuring that the implementation is more people-centred and positions new solutions in a way that speaks to staff and patients. HCD focuses on human needs and helps identify which parts of a process matter most to people and how the process fits into their jobs (health workers) and lives (patients). It simply helps to avoid working on the wrong problem. HCD also provides a framework for more deeply connecting diverse stakeholders in collaborations that generate creative interdisciplinary solutions.

For example, a Kaiser Permanente Northwest team has been working on how to better support family caregivers of patients with dementia. Patients and caregivers are often unclear about what follows an initial diagnosis by a primary care provider (PCP), while the providers often feel inadequately equipped with resources to address next steps. A group that included family caregivers, PCPs, memory clinic specialists, social workers, and an Alzheimer's Association representative created a prototype of a pre-configured electronic health record feature to trigger appropriate referrals that PCPs could use to initiate a smooth and timely care path. PCPs who didn't participate in the co-design session tested the prototype, reporting that their confidence about providing appropriate support and resources for caregivers increased more than threefold, from 1.8 to 6.2 on a 10-point scale. The feature met the needs of caregivers, PCPs, and social workers and is currently poised for spread throughout Kaiser Permanente Northwest. In general, Kaiser Permanente staff members who were using HCD methods in performance improvement and innovation work, reported feeling that they "*rediscovered joy in their work and 're-engaged with the organizational mission'*", and that HCD helped them "*see the value in the services they provide*".

Source Kachirskaia, Mate and Neuwirth: (2018[51]), "Human-Centered Design and Performance Improvement: Better Together", https://catalyst.nejm.org/hcd-human-centered-design-performance-improvement/.

4.5. Conclusion

A digitally capable and enabled workforce is needed to embrace the use of technology and data. The experience from within the health sector as well as other industries demonstrates that investing only in the digital infrastructure without engaging the workforce and supporting the development of new skills does not allow to realise the full potential of digital innovations. In fact, the technology can even get in the way of work.

In particular in the health sector, putting technology to productive use requires a balanced approach; using digital data effectively is not simply about the technology, it is mostly about the people by which it is used but also those for which it is used, i.e. the patients. Therefore, any national eHealth strategy should involve a thoughtful blend of funding and resources for infrastructure, and, the often missing support for the engagement as well as the education and training of the health workforce.

Whether and how the emerging skills needs are identified and addressed defines the success of the digital transformation in health service delivery. Governments in some countries are already making structured efforts to assess the skills demanded and the commensurate implications for health workers education and training, or actively engage in amending the health education and training curricula. However, much remains to be done. Evidence suggests that, currently, the front-line health workers do not feel sufficiently prepared and health care organisations lack a cadre of clinician leaders with the necessary skills in health care improvement and redesign of care enabled by digital technologies. Additionally, there is a lack of workforce capacity amongst both clinician and non-clinician informatics professionals. This deficit poses a serious barrier to progress and needs to be remedied.

The early efforts to build the required capacity within the health workforce will need to be supported and expanded. In particular, more attention needs to be directed to the Continuous Professional Development programmes to ensure that the skills the current health workers need for an effective and safe use of emerging digital technologies are taught routinely and that the health workers have time to acquire them.

Furthermore, both the issues of skills supply and demand need to be considered simultaneously, in particular for the very much needed cadre of clinical leaders in digital technology. Without the availability of full-time jobs with a sustainable career track, few talented individuals will choose to leave the practice of clinical medicine, nursing, or pharmacy to obtain additional training and certification in health information technology.

Health jobs are unlikely to be automated in the foreseeable future. However, as technology augments health workers' tasks and roles, regulations need to allow for expanding or reassigning these tasks and roles. The augmented workflows need to be recognised in provider reimbursement models to allow the technology to add value. Therefore, health sector employers need to be incentivised to embrace new technology and recognise the need for change in the workforce and work processes. Otherwise, the adoption of digital technologies might simply lead to digitising the current analogue processes without increasing effectiveness and efficiency. The digital data system's implementation itself (plus getting used to using it) takes a considerable amount of time of almost every front-line health worker in a health organisation and must be accounted and allowed for.

Moreover, in order to avoid the implementation of systems that can create opportunities for errors and can result in frustrated health professionals and patients, digital tools and systems must be designed with the input of end-users, employing basic principles of user-centred design. The current practice of digital tools being developed with little or no insight and/or input from health workers must be adjusted to ensure that sufficient information on their design and quality of the data used is not only made available by the producers, but that relevant health professionals are involved in the design process. Creating and enacting campaigns to engage front-line health workers should be an integral part of the digital transformation in every organisation in the health sector. Health care provider organisations and funders should also consider supporting academic or other partners in research assessing the usability of emerging digital systems and tools using validated assessment methodologies. Such reviews could then factor into decisions regarding the purchasing and implementation of the digital systems and tools.

Finally, there is also a need to update professional and ethical frameworks along with educational and training curricula and work processes, such that health workers can trust, and know how to work with the machines, AI in particular. The stakes are decisively higher when a digital tool affects clinical outcomes rather than consumer-oriented tasks in the wider economy. While it is widely recognised that advances in data analytics have and will continue to change the practice of health care, the development of adequate professional and ethical frameworks is lagging behind in most countries. Professional associations of health workers only start to explore the legal implications of the use of AI in health care, such as issues of liability or intellectual property, and advocate for appropriate professional and governmental oversight for a safe, effective, and equitable use of and access to AI related tools.

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Notes

[1] See also Chapter 2.

[2] In the figure, the comparatively small estimated risk of automation for health sector jobs is even biased upwards. This is because the data used does not include some of the job tasks typical for most health sector jobs – for example, some tasks that have to do with direct patient care (caring for and assisting others) – that are especially difficult to automate, given the current state of knowledge. In effect, the probability of automation for the health sector jobs is calculated based on only a (small) subset of the tasks that are found in the majority of health sector jobs.

[3] Also called health care informatics, health care informatics, medical informatics, nursing informatics, or biomedical informatics.

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