# Digital skills gap in the healthcare sector

## Technical report


### Authors

**Dr Michael Loizou**
Assistant Professor
Centre for PostDigital Cultures

**Dr Zimu Xu**
Lecturer in Enterprise and Entrepreneurship,
International Centre for Transformational Entrepreneurship,
Faculty of Business & Law

### Collaborators

**Prof Louise Moody**
Professor of Health Design and Human Factors;
Theme Lead for Wellbeing and the Arts,
Centre for Arts, Memory and Communities, Coventry University

**Prof Sylvester Arnab**
Professor of Game Science at the Disruptive Media Learning Lab,
and an associate of the Faculty Research Centre in Post digital Cultures, Coventry University

**Dr Mai Rashed (MSc MBBCh)**
Medical Physician
MSc in Global Healthcare



# Contents



## Glossary of terms

| Term | Definition |
|---|---|
| VR | Virtual Reality generally refers to a simulated experience that can be similar or different from the real world. |
| AR | Augmented Reality refers to a type of interactive, reality-based display environment facilitated by computer generated display, sound, text and effects to enhance the user's real-world experience. |
| XR | Extended Reality refers to all real-and-virtual environments generated by computer graphics and wearables. |
| AI | Artificial Intelligence is the broader term that refers to methods which allow computers to copy human intelligence using decision trees and machine learning. |
| Immersive training | Immersive training or immersive learning places individuals in an interactive learning environment, either physically or virtually, to replicate possible scenarios or to teach particular skills or techniques. |
| Machine learning | The category of AI that pertains to statistical methods to allow machines to efficiently finish tasks by experience. Deep learning is a subcategory of machine learning. |
| IoC | Institute of Coding |

# Executive summary

In the last decade, the UK healthcare sector has been facing enormous complex challenges induced by the rising aging population, increased medical complexity, growing demand for healthcare services made worse by staff shortage, financial deficit, undesirable levels of efficiency and cost effectiveness (Deloitte Centre for Health Solutions, 2019).

These challenges are neither new nor unique to the UK, with strong evidence that global healthcare systems face similar challenges (Lluch, 2011). As a response, governments in different countries have developed strategies for investing in healthcare technologies and information management (Lluch, 2011) for the perceived benefits of improving patient outcomes (Quilter-Pinner and Muir, 2015; Department of Health & Social Care, 2018; Deloitte Centre for Health Solutions, 2019; Jones et al., 2019). Such improvements include, but are not limited to, improved drug management, decreased costs, enhanced patient experience, improved diagnosis and treatment, improved disease management and remote monitoring of chronic diseases (Deloitte Centre for Health Solutions, 2019).

Specific policies have been setup in facilitating this digital health transformation process. For instance, the European Commission has approved the Privacy Code of Conduct on mobile health apps and adopted the recommendation which facilitates the exchange of cross-border health data as part of digital transformation of health and care in the UK (European Commission, 2018 and 2019). In the UK, NHS Digital has developed a set of interoperability standards on clinical IT systems in building an integrated digital health network (NHS England, n.d.). An open application programming interface architecture policy and supporting guidance has also been developed by NHS England and has laid out key expectations for healthcare organisations (Jones et al., 2019).

Digital technologies are recognised as a key component in healthcare transformation in the NHS Long Term Plan (2019). The UK has the potential to take the lead on healthtech but to do so, decision makers need to address challenges such as legacy technologies and commercial arrangements, inefficient organisational and delivery structures, risk-averse culture, limited available resources, a critical need to build and maintain public trust through enhanced privacy and security practices, fragmentation and variations towards digital transformation, and an increased gap between reality and policy ambition (Department of Health and Social Care, 2018).

In this context, the IoC has commissioned this report to examine how higher education providers can work with policy makers and HR departments in the healthcare sector to ensure a better alignment between technological change and staff skills.  As a national organisation the IoC covers 33 universities and over 100 employers across England and Wales and aims to deliver productivity improvements for the UK through investment in higher level digital skills.

## Scope of the report

This report focuses on how higher education providers can engage with healthcare sector management to identify current and emerging digital skills gaps, as well as opportunities for supporting transformative change.

The report is guided by the priorities of the Department of Health and Social Care (2018): put the right infrastructure in place, ensure that digital services meet peoples' needs, enable healthtech and innovation, develop the right skills and capabilities, and build an open culture. In this report, we have found that the implementation strategies, as outlined by the UK government, are likely to face barriers due to a lack of digital skills across a range of levels (e.g. senior management, front-line healthcare practitioners and back-end officers) and higher education providers will need to work with healthcare providers to address: knowledge in leading digital transformation in the NHS, adapting to state-of-the-art technologies, utilisation of data and data analytics, as well as, educating healthcare practitioners and patients. Thus, the focus of the report is to provide a guide for education providers to understand the opportunities and challenges in responding to the healthcare sector's digital skills needs.

## Key technologies

Currently, key digital technologies implemented in the healthcare sector includes:

- **AI and machine learning:** widely used in analysing data, especially big datasets
- **Human communication:** digital technologies to assist and improve communications such as chatbots
- **Self-management and wellbeing:** digital technologies that support people to measure and manage their conditions and treatment, such as the use of various healthcare apps or wearable devices, in collecting and feeding back data
- **Assisted living technology:** digital technologies that assist people to be more independent with their everyday activities

Together with data sciences, digital health technologies have become an integral part of modern living.

## Trends

**Data analytics and machine learning** have been increasingly discussed as data quantity grows exponentially. Data offers a fresh perspective for the NHS to enhance and conduct more research. With providers moving more deeply into the realm of value-based care and population health management, an agile and robust big data analytics team will become even more critical for maintaining revenue and raising quality.

**AI** in healthcare is currently considered to be much more rooted than merely a digital tool as it plays a significant role in labour force.  For example, it can not only assist administrative and clinical roles but can also allow physicians to be more humane. While resistance is still evident from the public, AI has been adopted and designed for making services more patient-centred (Loder and Nicholas, 2018).

**Overcoming data separation** between different parties (e.g. hospitals and family doctors, social and clinical services, patients) involved in healthcare has been essential. Overseen by extensive regulation and policy guidance, open platforms, for example, can impel an integrated system over fragmentation and separation (GSMA, 2017).

**Remote care** is a cornerstone of NHS England's digital vision. The NHS Long Term Plan (2019) aims to provide convenient ways for patients to access advice and care through telephone and video consultations, specific healthcare platforms and the use of innovative devices (e.g. smart inhalers, apps) in the next five years.

**Extended reality (XR)** technologies provide a bridge that connects people, places and information. As the technology advances, it becomes more capable of overcoming distance issues of the healthcare industry. XR technologies can facilitate training (e.g. for surgeons), create environments for condition recovery (e.g post-traumatic stress), and provide virtual scenario opportunities among others.

Increasingly, digital health transformation is dealt more and more from a **holistic ecosystem approach**, addressing aspects such as the supply chain and strategic partnerships. It is recommended and implemented in a way that the government, healthcare organisations and the industry need to work together to realise the ambition in using technologies and becoming the global leader in healthcare.

## Skills gaps

Various skills gaps are identified among front-line healthcare practitioners, senior-management and back-end officers (staff who analyse digital data collected). Senior management plays a key role in taking the digital revolution forward. However, research has found that management groups generally lack sufficient understanding on the value and application of digital technology for effectively guiding and driving digital transformation. Front-line practitioners who are dealing with patients on a daily basis need to be equipped with sufficient knowledge and skills on how they can use the data collected (Castle-Clarke and Imison 2016). Moreover, they are expected to take an active role in effectively educating and supporting patients in adopting and persistently using digital tools for best results (Castle-Clarke 2018). However, health professionals often do not express confidence enough to use or recommend certain digital solutions as there is a lack of understanding of the design logic behind them. In this field, the healthcare sector faces difficulties hiring staff with sufficient skills to fulfil the goals of data analytics (Terahard 2017).

In addition, drawn from interview conversations, fundamental gaps that need to be addressed are building up familiarity, creating a supportive culture and shifting people's perception (to be proactive and positive) of using new digital technologies that were not previously introduced into the system.

## Training programme recommendations

In addressing the identified skills gap, the report recommends five training programmes be developed as a result:

1. Training programme to equip senior management with a sufficient level of understanding on the importance and urgency of digital transformation. Moreover, the holistic ecosystem approach is included to help senior management make strategic decisions in terms of allocating resources and supporting the digital transformation.
   **Delivery mode:** Online course or blended learning as CPD programme.
2. Training programme to increase front-line health practitioners' general confidence, familiarity and skills with digital technologies. The programme will incorporate immersive training systems and include the use of different types of digital technologies.
   **Delivery mode:** Scenario based learning, online or blended, or work-based CPD programme.
3. Training programme for dealing with security concerns and basic knowledge of data analytics for people involved in all aspects of digital healthcare.
   **Delivery mode:** Scenario based learning, online or blended, or work-based.
4. Training programme targeting communication skills to address the concerns raised in relation to the communication efficiency between front-line healthcare professionals and back-end officers.
   **Delivery mode:** Scenario based learning, online or blended, or work-based.
5. Training programme to provide opportunities for people to develop data analytics skills with a focus in healthcare.
   **Delivery mode:** Blended or challenge based or work-based programme (CPD or data analytics degrees).

As seen from the above training recommendations, many are additional programmes for existing staff. Thus, for these to be successful, it is essential for healthcare organisations' HR departments to work together with training providers to not only ensure the courses are designed with the most up-to-date requirements, but also for timing and other practical arrangements to be facilitated with minimal disruption.

# 1. Introduction

The importance of managed technological change in the healthcare sector cannot be overstated at a time when financial and demographic pressures demand radical solutions to continue improving patient care and wellbeing.

The IoC is working closely with the healthcare industry to identify and respond to the digital skills requirements that may unlock much needed improvements in efficiency and care.  As such, this report aims to provide a guide for education providers to understand the opportunities and challenges in responding to the healthcare sector's digital skills needs. To serve this purpose, this report provides a review of literature sources and an examination of how these aims relate to observations "from the ground", as indicated by 14 semi-structured interviews with participants involved in all aspects of healthcare. The participants are influential members from the industry, education and healthcare sectors. During the period of May to July 2019, interviewees were carefully selected to ensure a good representation of the different sectors, gender and age group. The majority of the interviews were conducted over the phone or via Skype. Appendix 1 shows the demographic information of each participant.



# 2.  Key technologies and drivers for change

Currently, key digital technologies implemented in the healthcare sector include:

- **AI and machine learning:** widely used in analysing data, especially big datasets
- **Human communication:** digital technologies to assist and improve communications such as chatbots
- **Self-management and wellbeing:** digital technologies that support people to measure and manage their conditions and treatment such as the use of various healthcare Apps or wearable devices in collecting and feeding back data
- **Assisted living technology:** digital technologies that assist people to be more independent with their everyday activities

Digital health technologies offer a massive potential to transform healthcare by making it considerably more responsive to consumers' needs, convenient for patients to access, and efficient and satisfying for providers to deliver in terms of cost saving (IHS Markit, 2019). For instance, innovative technologies can help to boost NHS productivity by 1.5%-3% compared to their historical average which ultimately can help to reduce financial deficiency (Quilter-Pinner and Muir, 2015). In 2015, Tim Kelsey, the then National Director for Patients and Information at NHS England, stated that an estimated £8.3bn-£13.7bn savings could be made through digitising the NHS (House of Lords, 2018). Regarding operational efficiency, digitalisation raises the bar to a whole new level of excellence. This is made obvious where significantly better standards of systems integration were achieved through enhancing patients' throughput processes. An example of this is the use of insulin pumps for people with type 1 diabetes where, compared to self-management, using such a pump can reduce unplanned hospital admissions, complications caused by mismanagement, and long-term deteriorations (Quilter-Pinner and Muir, 2015) which not only improved operational efficiency but also reduced cost. Additionally, digitalisation offers the option of AI-based analysis that highly contributes to decision support.

Finally, via VR and remote surgery access, digitalisation allows for an optimal team-oriented approach. On a similar note, significant efficiency advantages continue to prove the usefulness of digitalisation as a tool in a wide variety of applications. For example, Research and Development cost savings of over 20%, on average, were achieved. This improvement was made possible through the optimisation of clinical trials, for example, by advancing processes of recruitment as well as by sequencing patients according to digitally gathered biomarkers. A second advantage to digitalisation is seen in the application of production, marketing and sales that were powered by AI and big data where potential efficiency surges are predicted (Schermer and Brunninger, 2018).

# 3. Trends

**Data analytics and machine learning** is a growing priority for healthcare providers in all aspects of both the supply chain and care pathway. As the focus shifts towards efficiency, value-based care and population health management coordinated and agile data analytic capabilities are critical for raising both quality and addressing revenue. Data offers a fresh perspective for the NHS to enhance and conduct more research. This is in addition to AI which also offers a novel analytical method for triage, logistics and for diagnosing patients (Castle-Clarke, 2018). For instance, the Clinical Support Unit, which is a part of the Somerset Primary and Acute Care Systems (PACS) Vanguard, partnered up with York University to provide user-friendly datasets on the entire health and social care across Somerset (Marjanovic et al., 2017). Resources across the community can therefore be shown, allowing an extensive picture to be drawn on the possible challenges, population-based needs and appropriate service design innovation (ibid). Efficient data management and analysis entails good practices in storing and using data which not only enables data analysis but also addresses issues on privacy and lack of interoperability.

**AI** in healthcare is currently considered to be much more rooted than merely a digital tool as it plays a significant role in labour force. Administrative and clinical roles are becoming more popular as AI allows more independent decision-making that is data-guided (Accenture Consulting, 2018). As AI can potentially automate part of the physicians' workload, it can improve the current situation of staff shortage and burnout (Academy of Medical Royal Colleges, 2019). AI can also provide direct-to-patient services which is not restricted to the time of the day, location or verbal communication (ibid). However, it shall be noted that with the usual clinical routines, patient safety remains a priority, and therefore AI technologies should be developed and tested with caution and rigour. An essential step in the adoption process is attaining public trust (ibid). While the potential of AI is acknowledged, developers have to be warned that public acceptance and trust should not be taken for granted (ibid). There is a possibility that the public would still view AI as providing unclear advice and acting as an obstacle to healthcare access. Nevertheless, AI has the potential to contribute to primary care services as it can make healthcare services more attainable and more perceptive to patients' needs therefore making services more patient-centred (Loder and Nicholas, 2018).

It is essential to **overcome data separation** between hospitals and family doctors, mental and physical health, social and clinical services as well as patients. This can only be done through novel care and integration models capable of a more efficient service provision (NHS England, 2014). A holistic perspective is much needed (Castle-Clarke and Imison, 2016). Overseen by extensive regulation and policy guidance, open platforms, for example, can impel an integrated system over fragmentation and separation (GSMA, 2017). For instance, an open application programming interface architecture policy and supporting guidance has also been developed by NHS England and has laid out key expectations for healthcare organisations (Jones et al., 2019).

**Remote care** or remote consultations are a cornerstone of NHS England's digital vision. A multiyear investment of £45m is intended to increase uptake of online consultations (NHS England, 2016). These are increasingly offered by GP practices, although uptake remains low. Rural healthcare has also benefited from remote care and digital technologies.

**Extended Reality (XR)** is an umbrella term that includes both virtual reality and augmented reality applications. XR technologies provide a bridge that connects people, places and information. As the technology advances, it becomes more capable of overcoming distance issues of the healthcare industry. Extended reality includes both virtual and augmented reality technologies which blur the lines between reality and simulation. Immersive experiences made common by XR technology overcome the distance problem as VR offers a virtual environment with headsets and hand-held controllers for navigation in a virtual space (Accenture Consulting, 2018). One example would be a home-based virtual setting for a surgery resident to practise with. Another is virtual environments allowing cognitive therapy for war veterans recovering from post-traumatic stress (Accenture Consulting, 2018). A real-life application is seen in Florida hospital Tampa utilising VR models for employees and patients. Through recreating real-life situations, XR provides training opportunities for employees. Moreover, patients and families are better able to comprehend medical conditions through an XR-recreated patient anatomy model. That way, patients are able to choose between different therapy options and doctors are able to make more patient-tailored surgical plans (Accenture Consulting, 2018). Experienced specialists would be able to teach novel techniques to medical residents in other country locations. This would mean that XR is more than capable of solving workforce problems by allowing businesses to find and grow the talents required and health organisations to locate the expertise needed from around the globe (Accenture Consulting, 2018).

Digital health should be dealt with from a **holistic ecosystem approach**, with a focus on the following factors: improvement of the healthcare supply chain, an increase of mergers and acquisitions in healthcare industries, and rising recognition of the digital health ecosystem concept. For example, Amazon's recent investments in healthcare intend to offer upstream and downstream solutions for the value chain of providers where Amazon Web Services (AWS) plays a supportive role (IHS Markit, 2019). Through integrating with Cloud technology, Amazon's AWS has adopted the concept of infrastructure-as-a-service. This could only have been possible through collaborations with the most common healthcare technology and life sciences vendors.



# 4. Overview of challenges

While there are significant benefits and advantages, there are also barriers when adopting digital technologies in the healthcare sector. Figure 1 illustrates the implementation cycle of digital health technology and associated challenges.

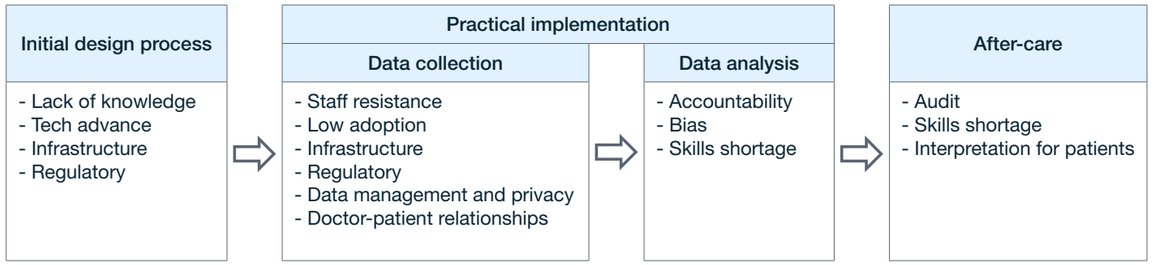



Figure 1. Digital health technology process and challenges

Four main challenges are identified in the initial product design stage. Firstly, Hostetter et al (2014) points out that there is a lack of knowledge and deep understanding of the health care field from digital health entrepreneurs and technologist as many of them come from other industries. This has resulted in products developed that are mainly based on personal experience or anecdotal reports rather than addressing the core safety and efficiency concerns of healthcare service delivery. Secondly, technologies are advancing quicker than the organisations' capability to keep up which poses challenges for leaders to effectively incorporate technology into healthcare (Accenture Consulting, 2018). Furthermore, regulatory systems are essential in addressing ethical and legal concerns (Academy of Medical Royal Colleges, 2019). Last, but not least, current digital infrastructure has grown out of date and is unable to keep up with the growing demand for the a hyperconnected environment (Accenture Consulting, 2018; NHS Foundation Trust, 2018). Immediate actions have been urged in addressing issues around bandwidth, remote storage, and affordability (Accenture Consulting, 2018; NHS Foundation Trust, 2018; Academy of Medical Royal Colleges, 2019). However, such improvements require sufficient funding which may lead to further barriers in some places.

**"I think the first one has got to be the infrastructure. You've got to have the devices, the Wi-Fi. Then again Wi-Fi sometimes struggles in hospital environments. You've got to have the access to the enabling technology before you can even begin to think about the application side of it."** – P002

**"For example, virtual reality learning environments, no hope at the moment within hospitals."** – P009

During the practical implementation stages, we have identified nine key challenges in the reviewed literature. Firstly, in the absence of what is known as a clinical champion, staff can be reluctant to change (Castle-Clarke and Imison, 2016).

In addition, the lack of trust from both consumers and clinicians in adopting digital health technology (e.g. AI) can lead to hesitancy of adoption (Accenture Consulting, 2018). Concerns have also been raised over data management practices and associated privacy issues (Hostetter et al 2014; European Commission 2018; Academy of Medical Royal Colleges, 2019). Moreover, accountability during the decision-making process, particularly when AI is involved, is still in question (Academy of Medical Royal Colleges, 2019). There further exists a challenge related to inequalities and biases when using AI when training data is non-representative (Ibid). Doctor-patient relationships are also expected to be influenced by digital technologies such as AI where a significant shift is expected (Ibid). Concerns over skills shortage have been frequently brought up. Finally, infrastructure and regulatory systems can affect this implementation process (NHS Foundation Trust, 2018; Peters et al 2017).

Castle-Clarke and Imison (2016) reported that the NHS industry is seen by many as a slow adopter of digital technology and this has become a major concern to policy makers looking to eliminate tech unfamiliarity of NHS consumers and patients alike. Moreover, it is debated that the constant updates required for using digital tools could introduce an extra burden to patients. Therefore, patients' and staff members' disinclination to adopt technologies is to be expected. In addition, Brexit is also a concern regarding the workforce. For instance, 13% of nurses in the UK are originally from overseas. The fact that training a doctor requires 10 years and a nurse 3, makes addressing current workforce insufficiencies a priority.

In the "after-care" stage, three main concerns were raised. Firstly, Kennedy and Yaldren (2017) recommend an audit must be made on all current digital capabilities of the workforce and the provision of full support to digital champions for working with staff members and patients to improve the care service. Secondly, skills shortage may also prove to be a challenge in this stage. Challenges were further identified in educating patients and interpreting clinical data for patients (Castle-Clarke and Imison 2016).

# 5. Skills gap

As mentioned above, Tim Kelsey, the then National Director for Patients and Information at NHS England, stated in 2015 that an estimated £8.3bn - £13.7bn savings could be made via digitising the NHS (House of Lords, 2018). In overcoming these barriers and thriving to be the global leader in healthtech, the Department of Health and Social Care (2018) has set out four priorities: put the right infrastructure into place, ensure that digital services meet people's needs, enable healthtech and innovation, develop the right skills and capabilities and build an open culture. These priorities are guided by four principles: services to be designed around users and their needs, maintain public trust through ensuring privacy and security, embrace interoperability and openness, and ensuring inclusion with diverse needs in mind.

Through this project, we have found that the implementation strategies as outlined by the UK government are likely to face barriers due to a lack of skills across different levels (e.g. senior management, front-line healthcare practitioners and back-end officers) in various aspects such as sufficient skills and knowledge in leading digital transformation in the NHS, adapting to state-of-the-art technologies, data analytics and educating others.

## 5.1. Different strata / specific digital skillset

Skills gaps are identified among front-line healthcare practitioners, senior-management and back-end officers (e.g. Deloitte, 2017; Lodar and Nicholas, 2018; Academy of Medical Royal Colleges, 2019; The Topol Review, 2019). Moreover, the majority of the interviewees expressed the view that training was also needed for acquiring specific digital skillsets such as using particular software or equipment, or tailored training/ support for different groups (e.g. senior management; front-line practitioners; back-end officers).

**Senior-management**
The leadership role of senior management is crucial to ensuring digital transformation, organisational change and the benefits for patients are all aligned. However, managers often did not start their training in a data-intensive environment, so there are significant gaps and variations in their understandings of how different technologies can be applied to address business and health priorities.

**"My worry is the gap between all the managers that need to be trained."** - P007

Thus, senior-management not only needs to enhance their understanding on the value of digital technologies in healthcare, but also develop sufficient skills and knowledge in effectively leading the transformation, for example within the NHS (Deloitte, 2015; Oxford Analytica, 2017; Loder and Nicholas 2018). Such skills go beyond traditional aspects on managing finances or human capacity but also demand for an ability to motivate staff to deliver change and ensure that a supportive infrastructure is in place (Maguire et al 2018).

**Front-line health practitioners**
In the digital health space, front-line health practitioners are also expected to take on roles of effectively educating and supporting patients in adopting and persistently using digital tools (Castle-Clarke 2018). To benefit from digital technologies, front-line staff also need to be equipped with sufficient knowledge and skills on how they can use the data collected (Castle-Clarke and Imison 2016). They are also in a position to recommend digital tools and encourage patients' adoption which requires skills and knowledge (Ibid). The possibility of remote care also demands for a different set of skills (see Appendix 2 for more details). However, health professionals are generally not feeling confident enough to use or recommend certain digital solutions as there is a lack of understanding on the design logic behind these.

Although skilled staff, such as nurses or doctors, may not have a skills shortage in that area per se, the majority of the interviewed participants reported that healthcare professionals require basic generic digital skills. These include digital communication skills, in particular, incorporating digital technologies in their signposting advice.

**Back-end**
Back-end officers refers to staff who analyse digital data collected. Terahard (2017) reported that nearly half of global businesses, including ones in the healthcare sector, face difficulties hiring staff with sufficient skills to fulfil the goals of data analytics. While some interviewees acknowledged that "there are pockets of people with the right skills (P007)", the majority of the interviewees believed that more training is needed for data processing and analytics' related tasks in general.

Data collection and analytics: front-line and back-end analytics and machine learning have been increasingly discussed as data quantity grows exponentially. Data offers a fresh perspective for the NHS to enhance and produce more research (Castle-Clarke, 2018). Usually, the staff working on the analytics are hired experts, and then the interpretation is done by the doctors, or the nurses, or the experts, when given the data. Therefore, some participants have dismissed the need for health professionals to acquire skills for data analytics. However, three participants, including one healthcare professional (consultant psychiatrist) reported that the reason data is not currently being collected properly is highlighted by the fact that the healthcare professionals do not understand data analytics or what the data to be collected is going to be used for. Discerning what kind of information needs to be collected is an essential pre-step for effective data analysis.

**"If you are interested in patient flow in a hospital, this is what you actually want, not just a spreadsheet of a patients list."** - P007



As a consequence of not having the right information collected, it has also been reported that a lot of the user cases are just stuck in the pilot stage and are struggling to move beyond that phase. Then again, as echoed by P009, it can be argued that the reason an average healthcare professional does not have skills to perform data analytics is simply because it is not part of their role. P008 also believes that there is no "digital skills shortage anywhere at the moment" as long as right collaborations can be formed. This observation speaks to the need for more people skills in bringing together and marshalling diverse specialist skills.

## 5.2. General digital skills, familiarity, culture and perception

Skills gaps were identified among front-line healthcare practitioners, senior-management and back-end officers. This is echoed with interview participants who believed further training is needed for improving the general digital skills of both health practitioners and patients. Such digital skills refer to general use and familiarity of smart phones, tables, laptops, VR, AR and other types of digital devices. It was also often mentioned that age can play a significant role, where the younger generation tends to be more comfortable with using and learning about new digital technologies, whereas the ageing population tends to be less confident in embracing digital technologies.

Interviewees from different backgrounds expressed mixed views on the perception of basic digital skills. For example, P001, CEO of a company who provides digital solutions to the healthcare sector, believes that "not so much about the tablets and smart devices because that's pretty much a norm and everyday use for most of them" but recognises that support is needed for technologies such as AR and VR. On the contrary, interviewees who work in healthcare organisations believe that there is a large percentage of people who do not possess such general digital skills:

**"We're trying to put in digital systems, I think actually a lot of people work on the assumption that everybody can actually use a computer with competence, and that's certainly not the case."** - P003

In addition to general digital skills, the majority of the interviewees have brought up the topics of familiarity, perception and culture. This points towards a familiarity gap that needs to be addressed for people to feel comfortable with new technologies, a supportive culture to experiment and an open innovation model where new ideas can be fed up and acted upon.

**"It's not so much the skills, it's more the familiarity of using state of the art technology."** – P004

It is also worth noting that the arguments on general digital skills are also context specific in a sense that there are exceptions with certain hospitals or specific groups of people being more digital savvy than average. However, a few exceptions do not eliminate the need of caring for the vast majority.

## 5.3. Good practices in addressing skills gaps

Several good practices were also brought up during the interview on addressing the skills gap and realising opportunities. Firstly, the digital product designed should be both user-centric and user-friendly, regardless of whether it is to be used by health professionals or patients. This can not only reduce the burden on extra training needed but also reduce the resistance in adopting digital technologies. Secondly, a holistic approach should be adopted in the process of introducing digital transformation. Such an approach calls for a nation-wide strategy that considers all aspects of the stakeholders (e.g. health professionals at all levels, patients) guided by the appropriate management team. To achieve this, the strategy must overcome the hurdle of entirely top-down or bottom-up approaches to find the right balance between the two. Thirdly, a co-creation and external collaboration strategy is beneficial for utilising existing resources effectively and creating an enhanced understanding "more widely across the use of all those systems" (P014). Fourthly, the learning by doing (or applied learning) is also seen as a great way of training. Fifthly, tailored conferences are also brought up by some interviewees as a good way of sharing and learning good practices. Last but not the least, P013 shared that introducing the changes incrementally with a carefully thought through process is also a good way for reducing any adoption/change resistance.

### 5.4. Potential challenges related to skills gaps persisting

The first challenge relating to persistent skills gaps is the resistance in adopting digital health technology. Echoed with literature findings, 13 out of 14 interviewees reported to either have personally seen or believed that there is such resistance. Only P001 reported to not having seen such resistance but to rather think that "healthcare as a sector is an early adopter of any latest technology that does come out". Generally, the resistance has already led to delays in adopting up-to-date technologies and substantially make the process more costly and less efficient.

The second challenge in addressing the skills gap is on the lack of holistic strategies and lack of a clearly set national-wide digital transformation strategy or guidance with individual NHS Trust or organisations being left to decide on their own approaches. The lack of skills and sufficient knowledge, especially at senior management level, can lead to a lack of holistic strategies and result to fragmented systems and wasted efforts both at national and local levels.

**"They only keep looking at doing a project or so in isolation. That just then ends up sitting as a pilot with no real business results per se."** - P001

**"There are lots of stories where perhaps some technology has been adopted without thinking about how this is going to fit into the bigger picture."** - P010

Where the majority of the interviewees reported that there is a resistance in adopting digital health technologies, only one person (P001) reported a different view. As the CEO of a digital solutions provider and having worked with different healthcare organisations on various projects, P001's view is influenced by his experience which might be limited to certain groups and certain period of time. In part, such different opinions demonstrated the imbalanced development in different healthcare organisations. A holistic strategy should also take this into consideration.

While it is generally accepted that there is a lack of digital skills, concerns were also raised on what the appropriate level of expectations are. For instance, health professionals largely do not possess advanced data management and analytics skills. However, questions were raised whether they should be expected to possess such skills or to what level they should be competent. Such concerns should be addressed prior to designing and incorporating any training programmes into health professionals' jobs. Or perhaps, as other interviewees (P008 and P014) mention, effective collaborations with external partners could potentially be another way forward for addressing this issue.

It also is a fact that technology often needs upgrading and it may be difficult and costly for the healthcare sector to keep up with what is also often a highly regulated market.

It has been reported that there exists a fearfulness around what shared information will be used for. This, in turn, explains why several NHS systems are locked down. Moreover, there is a growing need for healthcare professionals to include digital technologies into their signposting advice for patients. Such security awareness related gaps needed to be narrowed to allow patients to trust technologies and understand what their information is shared for.

Other potential risks caused by a lack of skills and knowledge include an imbalanced workload, a breach of data protection laws and even a cause for deaths and injuries.



# 6. Lessons learned from other countries and proposed solutions

Various lessons have been drawn from studies in other countries:

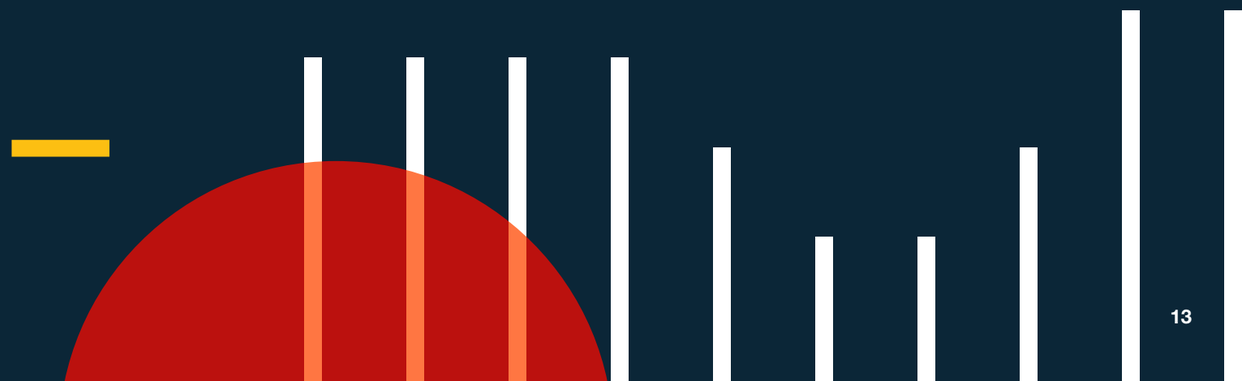
1. Industry collaborations are required to face current interoperability challenges that do not allow for asteady progress towards the integration of healthcare data;
2. A holistic ecosystem approach with all stakeholders involved is needed for a more integrated digital health sector;
3. Sufficient and appropriate government policy intervention and funding can help scale up the health digitalisation process;
4. Hospitals and clinics are also required to update ICT systems and to integrate digital health models;
5. Inadequate funds remain a persistent issue in developing countries with ongoing negative effects on service access, quality and health consequences;
6. The process of digitising patients is a lengthy one relating to technology as well as privacy concerns;
7. As a labour-intensive industry, it is essential to educate health professionals with the appropriate tech knowledge and equip senior-management with sufficient knowledge and resources to effectively lead the digital transformation (Oxford Analytica, 2017; GSMA, 2017).

For instance, through analysing the challenges in scaling digital health in emerging markets, GSMA (2017) proposed that an "ecosystem collaboration is needed to address current fragmentation and create a holistic digital health model" and "industry collaboration is also needed to address current interoperability issues and drive health data integration". In the report conducted for Accenture by Oxford Analytica (2017), one of the interview participants stated that they "had to gain control over data management and unify systems. Before, every island had its own system" several years before the study. They have been addressing this issue with considerable success by "introducing systems that are scalable, to accommodate the needs of different business areas".
In particular, it is reported that discarding legacy subsystems has seen significant efficiency improvement and cost saving (Oxford Analytica, 2017).

In responding to the identified trends and challenges, a number of more specific solutions have been proposed:

1. Defining opportunities for focusing on the country's greatest health and delivery system problems;
2. Closing knowledge gaps among stakeholders such as consumers, technology developers, entrepreneurs, health care executives, and investors;
3. Creating test beds in care settings;
4. Enabling a consumer-centred design and valuations of new technologies;
5. Addressing operational factors and challenges related to an evolving reimbursement and policy landscape (Hostetter et al, 2014; Oxford Analytica, 2017; GSMA, 2017; Slovensky, 2017).

In addressing the skills shortage, an initial step suggested is to accelerate experiential education where VR and AI can provide great opportunities for immersive training (e.g. design thinking in the board room, simulation training equipment and apprenticeships for on job training) (Accenture, 2018). Additionally, more vulnerable learners (e.g. older staff and staff in manual roles) require tailored support such as providing information on career pathways through modular training (Ibid). It is also recommended that efforts are to be directed towards individuals' incentivisation rather than institutions and graduates for increasing the skill mix on an individual basis. Health professionals are also advised to widen their skillset (Ibid). Finally, recognising the importance of collaboration among team members, team-based training is considered to best suited for these cases (Slovensky, 2017).



# 7. Recommendations

The need for a holistic ecosystem approach was identified from both literature and interviews. In addition to training people with specific skills for particular software, it is equally important to work on changing perception and culture and build familiarity which can have longer term benefits. In addressing the skills gap identified, five training programmes targeting different strata and skills perspectives are recommended. However, it should also be noted that, based on different opinions and experiences on what training is needed for effectively addressing the skills shortage issue, this will, inevitably, be a trial-and-error process.

Key learning and recommendations: Overall, both the literature review and interviews have confirmed that there is still a long way to go in order to close the digital skills gaps and bring about a successful digital transformation. Generally, skills gaps exist on various aspects and within different stakeholder groups: front-line healthcare practitioners need to become more confident in recommending and using digital technologies; senior management needs to acquire a wider and deeper understanding on what digital transformation means for effectively guiding the process; patients' skills and competencies also need to be taken into consideration when implementing digital technologies.

To address such skills shortages, it is necessary to adopt a systematic and holistic approach that addresses all aspects of the transformation process including creating a supportive culture, upgrading the infrastructure, and providing training for general and specific digital skills. To this effect, we recommend five main types of training for higher education (HE) to provide in addressing the identified digital skills gaps through innovative educational and training solutions:

1. Tailored training is needed for senior management. Firstly, senior management teams need to improve their understanding on the importance and urgency of digital transformation. As mentioned during the interviews, an immersive training method is well suited for this purpose. Secondly, the training should include sections on the holistic ecosystem approach in which elements such as culture, infrastructure, workforce education and development are discussed. In doing so, senior management can become more capable on allocating resources and supporting the digital transformation from the senior level.
   **Delivery mode:** Online course or blended learning as CPD programme.
2. Training programmes are needed to increase front-line health practitioners' general confidence and familiarity with digital technologies. An appropriate design of immersive training systems, including the use of different types of digital technologies (e.g. mobile apps, chatbots, AI and machine learning, assisted living technology, XR), could help with the training process. Such transferable skills, and a positive mindset developed as a result, can make the digital transformation more efficient in the long term.
   **Delivery mode:** Scenario based learning, online or blended, or work-based CPD programme
3. Training is also recommended for dealing with security concerns and basic knowledge of data analytics for people involved in all aspects of digital healthcare. Such training can help reduce resistance from both patients and health practitioners in adopting digital health solutions. Scenario based short courses.
   **Delivery mode:** Scenario based learning, online or blended, or work-based
4. In addressing the concerns raised in relation to the communication efficiency between front-line healthcare professionals and back-end officers, a programme targeting communication skills is also recommended. Training programmes or materials facilitated by immersive learning including the use of XR technologies can help the training process.
   **Delivery mode:** Scenario based learning, online or blended, or work-based
5. Although general training can partly prepare health practitioners for adopting the majority of digital health solutions, some more specific training might still be needed for using specialised software or performing specific roles. For instance, in addressing the skills gap in data analytics, training programme shall be designed to provide opportunities for people to develop their analytics skills with focus in healthcare.
   **Delivery mode:** Blended or challenge based or work-based programme (CPD or data analytics degrees).

For these recommendations to deliver the intended benefits, training departments need to work with practitioners and training providers to deliver a solution that fits the broader organisation culture and objectives, whilst creating minimal disruption to operations.

Future research: To address the skills gaps appropriately and effectively and make the holistic ecosystem approach possible, it is necessary to carry out a broader scoping study of the current situation of the digital healthcare sector. It is also essential to answer the more fundamental concerns in addition to tackling any general or specific digital skills training. For instance, what digital skills or at what level do healthcare professionals need to possess in the specific context of often already stressful and demanding jobs.



# References


Academy of Medical Royal Colleges (2019) Artificial Intelligence in Healthcare. [online] available from <https://www.aomrc.org.uk/wp-content/uploads/2019/01/Artificial_intelligence_in_healthcare_0119.pdf> [01 September 2019]

Accenture (2018) Digital Health Technology Vision 2018: Intelligent Enterprise Unleashed. [online] available from <https://www.accenture.com/gb-en/insights/health/digital-health-tech-vision-2018> [01 September 2019]

Castle-Clarke, S. (2018) The NHS at 70: What will new technology mean for the NHS and its patients? [online] available from <https://www.kingsfund.org.uk/publications/nhs-70-what-will-new-technology-mean-nhs-and-its-patients> [01 September 2019]

Castle-Clarke, S. and Imison, C. (2016) The digital patient: transforming primary care? London: Nuffield Trust.

Deloitte Centre for Health Solutions (2019) Closing the digital gap: shaping the future of UK healthcare. [online] available from https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/life-sciences-health-care/deloitte-uk-life-sciences-health-care-closing-the-digital-gap.pdf [01 Sept 2019]

Department of Social Care (2018) The future of healthcare: our vision for digital, data and technology in health and care. [online] available from <https://www.gov.uk/government/publications/the-future-of-healthcare-our-vision-for-digital-data-and-technology-in-health-and-care/the-future-of-healthcare-our-vision-for-digital-data-and-technology-in-health-and-care> [01 Sept 2019]

European Commission (2019) Digital Single Market. [online] available from <https://ec.europa.eu/digital-single-market/en/news/ehealth-adoption-primary-healthcare-eu-rise> [01 Sept 2019]

GSMA (2017) Scaling digital health in developing markets. [online] available from <https://www.gsma.com/mobilefordevelopment/resources/scaling-digital-health-in-developing-markets/> [01 Sept 2019]

HIS Markit (2019) How e-commerce can disrupt healthcare provision and distribution: The case of Amazon. [online] available from <https://technology.ihs.com/api/binary/612420> [01 Sept 2019]

Hostetter, M., Klein, S. and McCarthy, D. (2014) Taking digital health to the next level: Promoting Technologies That Empower Consumers and Drive Health System Transformation. [online] available from <https://www.commonwealthfund.org/publications/fund-reports/2014/oct/taking-digital-health-next-level> [01 Sept 2019]

House of Lords (2018) NHS and Healthcare Data Debate on 6 September 2018. [online] available <https://researchbriefings.parliament.uk/ResearchBriefing/Summary/LLN-2018-0091>[19 Jan 2020]

Jones, G.L., Peter, Z., Rutter, K. and Somauroo, A. (2019) Promoting an overdue digital transformation in healthcare. [online] available from <https://www.mckinsey.com/industries/healthcare-systems-and-services/our-insights/promoting-an-overdue-digital-transformation-in-healthcare#> [19 Jan 2020]

Kennedy, S. and Yaldren, J. (2017). A look at digital literacy in health and social care. British Journal of Cardiac Nursing, 12(9), 428-432.

Lluch, M. (2011) Healthcare professionals' organisational barriers to health information technologies—A literature review. International journal of medical informatics, 80(12), 849-862.

Loder, J. and Nicholas, L. (2018) Confronting Dr Robert: Creating a people-powered future for AI in health. [online] available from <https://www.nesta.org.uk/report/confronting-dr-robot/> [01 Sept 2019]

Maguire, D., Evans, H., Honeyman, M. and Omojomolo, D. (2018) Digital change in health and social care. London: The King's Fund.

Marjanovic, S., Sim, M., Dubow, T., Corbett, J., Harte, E., Parks, S., Miani, C., Chataway, J. and Ling, T. (2017) Innovation as a driver of quality and productivity in UK healthcare. [online] available from <https://www.rand.org/pubs/research_reports/RR1845.html>[19 Jan 2020]

Monitor Deloitte (2015) Digital Health in the UK: An industry study for the Office of Life Sciences. [online] available from <https://www2.deloitte.com/uk/en/pages/life-sciences-and-healthcare/articles/digital-health-in-the-uk.html> [01 Sept 2019]

NHS England (2014) Personalised Health and Care 2020. [online] available from <https://www.digitalhealth.net/includes/images/news0254/PDF/0172_NHS_England_NIB_Report_WITH_ADDITIONAL_MATERIAL_S8.pdf> [01 Sept 2019]

NHS England (2016) General practice forward view: April 2016. NHS England. [online] available from <https://www.england.nhs.uk/wp-content/uploads/2016/04/gpfv.pdf> [01 Sept 2019]

NHS England (2019) NHS long term plan to tackle major killer conditions and save up to half a million lives. [online] available from <https://www.england.nhs.uk/2019/01/long-term-plan/> [01 Sept 2019]

# References


NHS England (2019) A Digital Framework for Allied Health Professionals. [online] available from <https://www.england.nhs.uk/wp-content/uploads/2019/04/a-digital-framework-for-allied-health-professionals.pdf> [01 Sept 2019]

NHS England (n.d.) Interoperability. [online] available from <https://www.england.nhs.uk/digitaltechnology/connecteddigitalsystems/interoperability/> [019 Jan 2020]

Oxford Analytica (2017) CIO perspectives on digital healthcare-Saudi Arabia. [online] available from <https://www.accenture.com/sa-en/insight-cio-perspectives-digital-health> [01 Sept 2019]

Quilter-Pinner, H. and Muir, R. (2015) Improved circulation: unleashing innovation across the NHS. [online] available from <https://ippr.org/read/improved-circulation-unleashing-innovation-across-the-nhs#introduction> [01 Sept 2019]

Schermer, G. and Brunninger, M. (2018) The Promise of Digital Health. [online] available from <https://www.goetzpartnerssecurities.com/research/publications/publication/compass-the-promise-of-digital-health-report> [01 Sept 2019]

Slovensky, D. J., Malvey, D. M. and Neigel, A. R. (2017). A model for mHealth skills training for clinicians: meeting the future now. Mhealth, 3(24).

The Topol Review (2019) Preparing the healthcare workforce to deliver the digital future. [online] available from <https://topol.hee.nhs.uk/wp-content/uploads/HEE-Topol-Review-2019-printable.pdf>[01 Sept 2019]



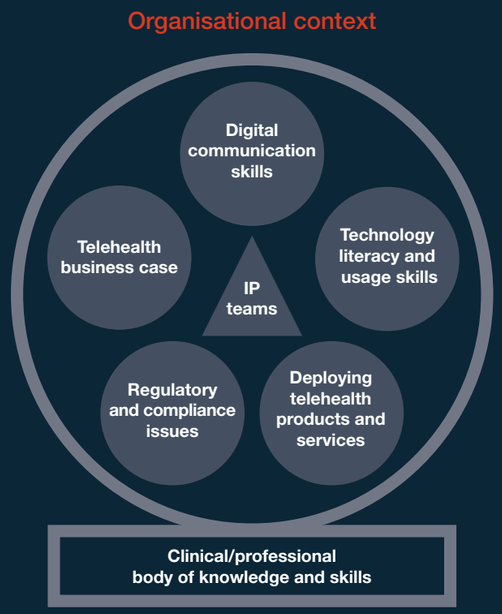

# Appendices

Appendix 1. Demographic Information of Interview Participants

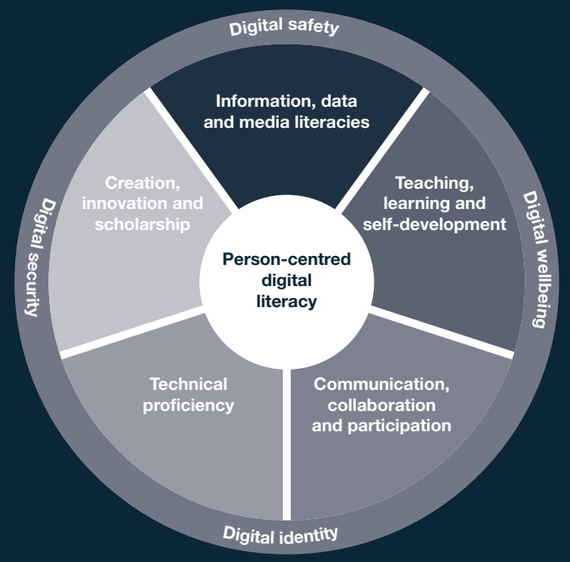
| Code | Education | Roles and backgrounds | Age group | Gender |
|---|---|---|---|---|
| P001 | BSc Engineering, MSc HR | CEO of a digital solution company, collaborated with the healthcare sector for 10 years | 31-40 | Female |
| P002 | BSc Engineering | Managing Director of a digital solution company, supplied digital products to healthcare organisations | 51-60 | Male |
| P003 | Nursing, MSc Healthcare Management & Policy | Deputy Chief Nurse in an NHS Trust | 41-50 | Male |
| P004 | PhD in Maths | Director of Research and team leader in a digital solution company, little experience in healthcare but good familiarity with research systems for digital health | 31-40 | Male |
| P005 | MA Animation | Developed digital systems for the NHS relating to immersive learning software, working in the Faculty of Life Sciences in a university | 31-40 | Male |
| P006 | MBBS | Consultant Psychiatrist for People with Learning Disabilities, consultant for in-out patients for over 30 years | 61+ | Male |
| P007 | MSc Physics | Currently a contractor for the West Midlands Academic Health Science Network. Has over 16 years' experience in NHS Digital field | 41-50 | Male |
| P008) | BSc Computer Science, MSc Interactive Technologies, PhD Human Computer Interaction | University lecturer, collaborated with the healthcare sector on several projects | 31-40 | Male |
| P009 | MSc Midwifery, Education in Midwifery, Public Health Practitioner | In Midwifery for 22 years, public health practitioner for 8 years | 51-60 | Female |
| P010 | BSc | 17 years' experience in healthcare and especially mental healthcare | 41-50 | Female |
| P011 | Degree equivalent in Supervision and Management | Director for Innovation and Economic Growth for the West Midlands Academic Health Science Network, 5 years in NHS and 15 years in industry | 51-60 | Male |
| P012 | MSc Healthcare Leadership, PhD candidate, Diploma in higher education as a paramedic | Paramedic for 11 years, worked in a number of UK healthcare organisations, predominately ambulance services, also a governor for the largest NHS Trust, also holds a key position related to health education | 31-40 | Male |
| P013 | PhD Risk Decision making and fuzzy logic, Advanced Diploma Archaeology, MPhil Occupational Safety and Health, Diploma Environmental Health | Director of a virtual heritage company, little direct experience in healthcare sector but worked with colleagues in health education related technologies | 61+ | Female |
| P014 | Master, PhD | Senior Designer of healthcare solutions in a university, designing healthcare products for the last 15 years | 41-50 | Male |

# Appendices

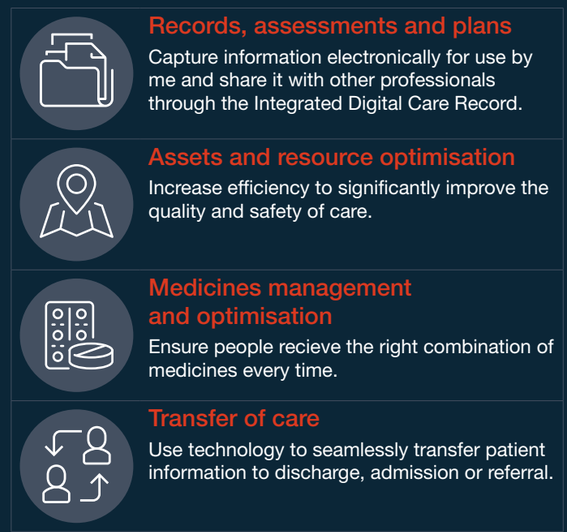
Appendix 2: The proposed organizational framework for a model of training and education on core competencies relate to mHealth (Slovensky et al., 2017)




Appendix 3: Framework for person-centred digital literacy (adapted from Jisc (2015) Digital Capacity Framework (Kennedy and Yaldren, 2017)




Appendix 4: Effective digital capabilities for AHP services



Coventry University
Priory Street
Coventry
CV1 5FB

E: **ioc@coventry.ac.uk**

www.linkedin.com/in/institute-of-coding-952013199

@IoC_CovUni

**www.coventry.ac.uk/business/partner-with-us/institute-of-coding**

**www.instituteofcoding.org**