DIGITAL HEALTH & CARE INSTITUTE

Review and Analysis of the Digital Health Sector and Skills for Scotland

A report by the Digital Health & Care Institute
in partnership with Skills Development Scotland

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Foreword

The pace of technological change has never been faster. Thus, the Education sector must be able to respond to these changes to ensure that workforce with right skills is being produced now and in the future.

Digital Health is a lucrative market both in the local and global contexts and requires a very diverse set of skills to meet the demands of employers. Complex and academic areas such as software development, data science and cyber security are integral to the sector. However, a gap currently exists between the provision of skills at different levels of the Education system and the skills demands of the Digital Health sector.

Collaboration between the Education sector and the industry itself is key to the success of bridging this gap. The Education system in Scotland is one of the best in the world and thus has the capacity to adapt to these changing requirements.
In order to realise Scotland's potential in the Digital Health market, we must ensure that our Education system has the ability to future-proof the workforce of tomorrow as we progress through the digital revolution.

Prof George Crooks OBE MBChB FRCP FRCGP

Executive Summary

This report has been produced by the Digital Health and Care Institute (DHI), as commissioned by Skills Development Scotland, to investigate and analyse the Digital Health sector and its skills issues in Scotland.

The Digital Health sector is characterised as emerging from the conjunction of health and care services, mobile health and ICT and it is one of the fastest growing economic sectors globally, hungry for skilled staff. In this report 'Digital Health' encompasses companies that produce, provide and service digital health solutions, and Health and Care service providers that utilize and implement digital healthcare solutions and tools in the delivery of their services. As the Health and Care sector catches up with the other economic sectors in digitization, the need for personnel in Digital Health and Care (both in the private and the public sectors) increases exponentially.

Digital Health is a diverse, interdisciplinary sector, (something that is reflected in the skills required in the field), ranging from higher level computing (such as Software Development and Software Engineering) to project management and business-related skills. There is a specific lack of personnel who are proficient in ICT and also have an understanding of health and care. However, while the sector is finding it hard to find suitably skilled graduates and to offer them competitive salaries, the unemployment among ICT graduates is higher than in other disciplines. Furthermore, currently there are only a handful of courses (and these are only on postgraduate level), offering Digital Health education in Scotland. The biggest single factor restricting economic growth in the sector is the lack of suitably skilled personnel. Digital health is going to face severe challenges in the near future, if the disparity between what the education and training provision offers and what the Digital Health sector needs, is not bridged. Currently, companies are using all available means to attract skilled employees, ranging from recruiting from other sectors, to offering in-house training, internships, Modern Apprenticeships and industrial placements to students and graduates.

In order for Scotland to capitalize on the expanding Digital Health market, it is vital to ensure that there is a sufficient supply of skilled workers entering into the sector. Based on the research discussed in this report the DHI have made several recommendations that focus on:

- Reviewing the existing education and training provision with digital health in mind;
- Involving Digital Health employees more closely in the development of the curricula in computing and health and care; and
- Raising the profile of the Digital Health sector in Scotland.

Summary of Recommendations

The DHI have made several recommendations to help improve the provision of Digital Health in Scotland:

1	Increase the availability and variety of Digital Health provision across all levels of education, whilst reviewing existing curricula.
2	Better involvement of industry in curriculum re-design for Computing and in building new Digital Health programmes.
3	Promote and increase the uptake of work-based learning and skills development for the current workforce.
4	Encourage integration of industrial placements in education.
5	Data Science should be seen as a key component of the Digital Health sector.
6	Improve the provision of digital skills across all levels of education.
7	Raise awareness and promote Digital Health as a career opportunity, to better define job potential in the sector.
8	Promote change management skills in the Health and Care sectors to enable digital transformation in the workplace.

Chapter 1 Introduction

Digitisation is no longer a new and emerging global phenomenon, it is a reality. The emergence of smart devices, sensors, mobile technologies, cloud computing, the Internet of Things and Big Data have had a major impact on the global economy, workforce and workplace. This includes the Health and Social Care sector albeit in the UK this currently lags behind other industries in their use of digital technologies by at least a decade [1,2,3]. These developments, referred to as the 4th industrial revolution, mean an extensive transformation of the landscape of work, which will affect the skills requirements for the existing and future workforce [4]. For example, 35% of jobs could become automated by the 2030's, leading to workers having to adapt to drastically changing work environments [5]. The demand for digital technology professionals has grown by 4% per annum in the past decade in Europe, especially in areas such as data analytics, cyber security, cloud and mobile computing; all essential elements of digital health and care [6,7]. In Scotland, over 60,000 people (2% of the workforce) work in technology businesses, and the Digital sector alone is estimated to require 12,800 new employees annually over the next five years to satisfy the need for a sufficiently skilled workforce [8,9]. Furthermore, the World Economic Forum (2016) predicts that 65% of children now starting primary school will be employed in jobs that do not currently exist, adding increased pressure on the need for digital skills development in Scotland [4]. Digital health has been defined as the "convergence of the digital and genomic revolutions within health, healthcare, living, and society" [10]. It can allow us to track, manage and improve both our personal health and that of our loved-ones, and has the potential to reduce inefficiencies in healthcare delivery, by improving access, reducing costs, increasing quality and by making medicine more personalised.

The Scottish Government's (2015) definition of Digital Health and Care is pragmatic and focusses on improving communication, stating that digital health is "the use of information, computers and telecommunications (ICT) to meet the needs of individuals and improve the health of citizens. It covers the electronic information recorded and shared between individuals and healthcare providers, peer-to-peer communication between individuals and/or healthcare professionals, and organisation-to-organisation transmission and sharing of information" (p.6) [11].

As digitisation underpins almost all of the aforementioned changes, and NHS Scotland further embraces digital health, anticipating the future skills needs and preparing the workforce for these developments is more important than ever.

The “Digital Health sector” consists of businesses and public sector employers, who specialise in a field, or offer job roles, which combine IT know-how with healthcare expertise.

The Digital Health sector is difficult to slice into sections, but for the purposes of this report a distinction is made between:

- Companies that produce, provide and service digital health solutions, and
- Health and Care service providers that utilize and implement digital healthcare solutions and tools in the delivery of their services.

This report will focus on the skills needs of both categories.

1.1 About this report

In this report, we will examine the Digital Health sector, the market size, job market and the skills required to feed the needs of the sector, as it continues to grow within Scotland. We will also explore what types of action the Scottish Education and Skills sector may need to take, in order to ensure a steady supply of skilled workers for the fast-expanding Digital Health sector.

Following the introduction in Chapter 1, the report will outline the definitions for some key concepts used in the report, discussing the spectrum of digital skills and the Digital Health sector in Chapter 2. Chapter 3 of the report explores the drivers behind the emergence of the Digital Health sector, followed by a review of the Digital Health market and the adjoined job market in Chapter 4. Chapter 5 looks at the skills required in the Digital Health sector and the predicted future skills needs. Chapter 6 reviews the existing education and training provision for the Digital Health sector in Scotland and the UK, with Chapter 7 detailing the conclusions and listing recommended actions to be taken by the Scottish Education sector to meet the future skills needs of the Digital Health sector.

This report consists of a combination of literature review and analysis, and consultations with key stakeholders within the Scottish Digital Health sector. The replies from the consultations have been embedded throughout the report in text boxes.

1.2 Consultations

The consultation were carried out to further study and understand the trends and skills requirements in the Scottish Digital Health sector. The consultees were with ten key stakeholders in the sector:

- A Social Care Organisation
- A Scottish Health Board
- Two Specialist Health Boards
- A Research Institute
- Five Digital Health SMEs

Among those we consulted with were Digital Health companies that produce, provide and service digital health solutions. Others were from the Health

and Care Service provision that utilise and implement digital healthcare solutions and tools, in the delivery of their services.

1.3 Methodology and Analysis

The consultations were carried out as structured interviews with representatives of Scottish, or Scottish-based Digital Health companies and organisations. Each stakeholder was asked the same series of scripted questions, available in Appendix 1. The purpose of the consultations was to gain an understanding of the skill sets that are most valued by the Digital Health industry, with a view of aligning these with formal education and training provision, to identify where the most prominent gaps lie.

The consultations were carried out by the authors of this report during Autumn 2017. The interviews were digitally recorded and transcribed. The transcribed answers were coded and organised into a matrix to be compared and contrasted for the purposes of analysis. The comparison of answers allowed us to identify emerging themes and analyse whether these aligned or diverged from each other, and from the trends represented in the literature. Among the consultee replies we took into account the characteristics of the organisation (private vs. public, size, age, location, purpose, etc.). A qualitative thematic analysis of the ten consultations was written up into vignettes that are embedded (where they are most relevant) throughout this report to help complement our literature review.

By virtue of the fact that we consulted with public and private sector organisations, the responses received were multifaceted, reflecting the diverse nature of the Digital Health sector. As the focus of the report is on skills required by the Digital Health industry in Scotland, the majority of the quotes embedded in the discussion are from the SMEs we consulted.

Chapter 2 Digital Health sector

2.1 Definition

The emerging Digital Health sector has no single definition, which reflects the dynamic and ever developing nature of the industry. It has been characterised as arising from the intersection of healthcare services, information technology and mobile technology and encompassing digital products that can monitor, analyse, educate and improve health [12]. At its most basic level, digital health is about electronically connecting points of care for easier and more secure sharing of health information [13]. This is also reflected in definitions that emphasize the changing nature of the patient-doctor relationship, which sees patients engaged as part of their own care teams, managing their health and wellbeing, through digital technologies, device and apps [14]. Overall, Digital Health is a fundamentally multi-disciplinary domain, incorporating disciplines such as Computer Science, Engineering, Information Science, Economics, Clinical Medicine, Public Health, Epidemiology and others [12, 15, 16].

The multidisciplinary nature of the domain is reflected in an overview of Scottish Digital Health carried out by Company Connecting (2017), which shows businesses stem from a great variety of sectors in this field [17]. The statistics, surprising as they are, demonstrate the trend in how the development of digital health in Scotland has unfolded, sourcing skills and resources from a number of sectors. The top ten sectors that Scottish IT companies, active in Healthcare, stem from, are [17]:

1. Financial Services
2. Public sector
3. Education
4. Government
5. Digital Health
6. IT
7. Oil and gas
8. Retail and Consumer Goods
9. Manufacturing
10. Transport

The Digital Health sector is commonly divided into four highly interrelated subsectors (displayed in Figure 1) [12]:

1. Telehealthcare: Telecare and telehealth provide support and assistance for a patient at a distance using ICT; the remote exchange of clinical data between a patient and their clinician using tele-communications.
2. mHealth (or Mobile Health): Refers to the use of mobile phones and wearable technologies that collect community and clinical health data; deliver healthcare information for patients, healthcare providers and researchers; perform real-time patient monitoring and the provision of direct care.
3. Health Analytics: Encompasses software solutions and analytical proficiencies required to integrate Big Data.
4. Digitised Health Systems: Describes the management, secure

storage and exchange of digital health information between patients and medical experts; for example using electronic health records.

According to Deloitte (2015), the key distinction between telehealth and telecare is that telehealth systems enable the user to exchange clinical data with their clinician, while telecare systems monitor users to provide assistance at a distance (for example falls detection) [12]. There is an increasing overlap with mHealth as it expands into the domain of telehealthcare. Traditionally, bespoke hardware-based solutions have been used as part of telehealthcare.

Modern mHealth provision consists of wearable technologies and applications, which users access via their mobile devices. Wearables are hardware products that monitor activity levels, heart rate, or sleep patterns, whereas applications are software-based health solutions ranging from consumer-driven wellness and fitness apps, to professional-driven medical apps. Health Analytics covers Data Analytics that relates to individual and population health, using both clinical and research and development datasets.

Digitised Health Systems are divided into patient-held and patient-controlled medical records and system-held health records. The former are more advanced digital versions of traditional paper records, with greater personalisation and functionality.

Interestingly, eHealth is not mentioned by Deloitte in this breakdown of digital health. This is possibly due to eHealth having changed somewhat since its conception. In its infancy, eHealth accounted for the application of electronic processes and ICT across the entire range of functions affecting the Health and Care provision. Over time, the meaning has changed to more specifically denote the field of medical informatics, which organises and delivers health services and information using the internet and its associated technologies. Whilst still existing as a sub-sector in Digital Health, eHealth has evolved to be shared across the divisions mentioned above. It could also be argued to have developed into Digital Health, meaning that the term “eHealth” is no longer needed. Digital Health is a more holistic, all-encompassing patient-centred approach to health and care, while eHealth primarily serves to benefit health service workers.

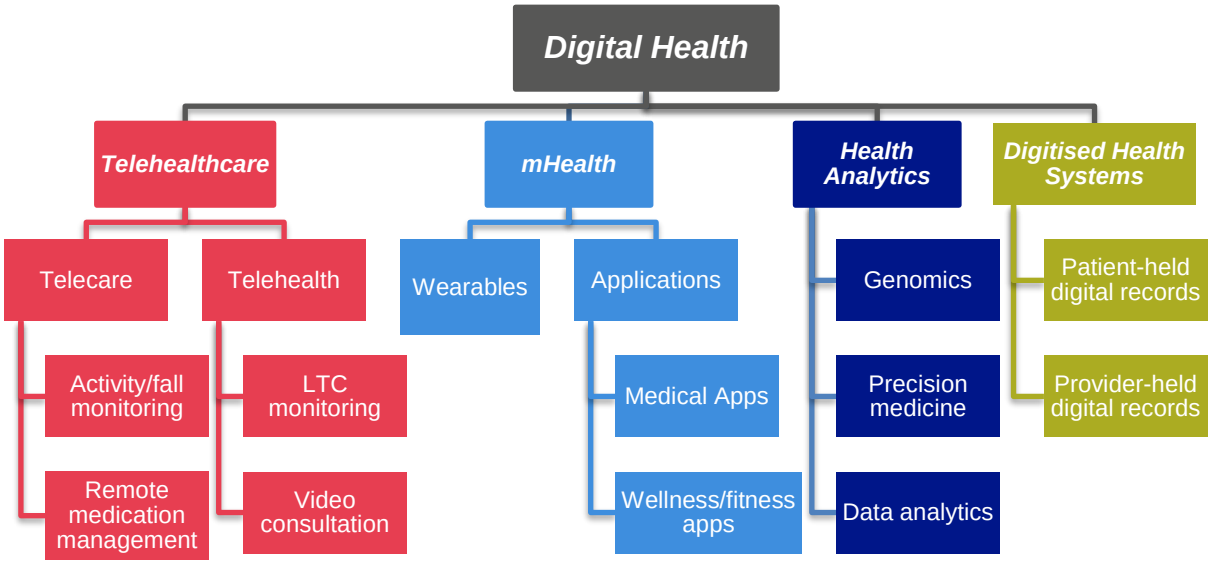

Figure 1: Sub-categories of Digital Health in the UK. Adapted from Deloitte UK (2015) [12].

2.2 Skills in the Digital Health sector

In order to realize the potential that the Digital Health sector offers for the Scottish economy and health services, it is vital to ensure a steady supply of skilled and capable employees for the digital health workforce.

When discussing *skills* in this report we are referring to *the ability to apply knowledge, using it to complete tasks and solve problems*. Skills encompass both cognitive (use of logical, intuitive, creative thinking) and practical capabilities (entailing manual dexterity, use of methods, materials, tools and instruments) [18, 19]. Practical knowledge and skills are instrumental for developing and applying advanced skills. Advanced skills, on the other hand, rely on being able to use practical tools and media and are needed for the application of practical skills on specific tasks, or strategies [20].

Additionally, we define competency as the *"ability to use knowledge and skills with responsibility, autonomy and other appropriate attitudes to the context of work, leisure and learning*[l]*"* [20, 21]. Competency encompasses not only practical and advanced skills, but also the knowledge, attitudes, ethics, values and priorities that motivate continued competent performance.

Where competencies relate to "current practices in known roles", *capabilities* in turn is a future oriented term, which refers to *new and emerging professional challenges*, and focuses on how to prepare for them [21]. The distinction between competencies and capabilities, as defined here, is useful to keep in mind, especially when discussing the future skills needs. A brief summary of the above can been seen in Text box 1.

[l] Ala-Mutka 2011, p. 18; cf. Royal College of Nursing 2017.

- *Skills* refer to the set of abilities required by staff to perform a particular job well.
- *Competence* refers to what the person is already able to do.
- *Capability* is about transferrable skills and the ability to meet emerging challenges in working life.

Text box 1: Definition of skills, competencies and capabilities

2.3 Spectrum of digital skills and capabilities

By definition, the workforce within the Digital Health sector requires both ealth and Computer Science related expertise. Given the diversity of roles available within the sector (discussed further in Chapter 5), it is useful to explore the digital proficiency requirements across these roles. The ECORYS report helpfully divided different digital skills definitions and frameworks into three broader categories (these can be seen as Categories 1, 2 and 4 below, in Figure 2) [22].

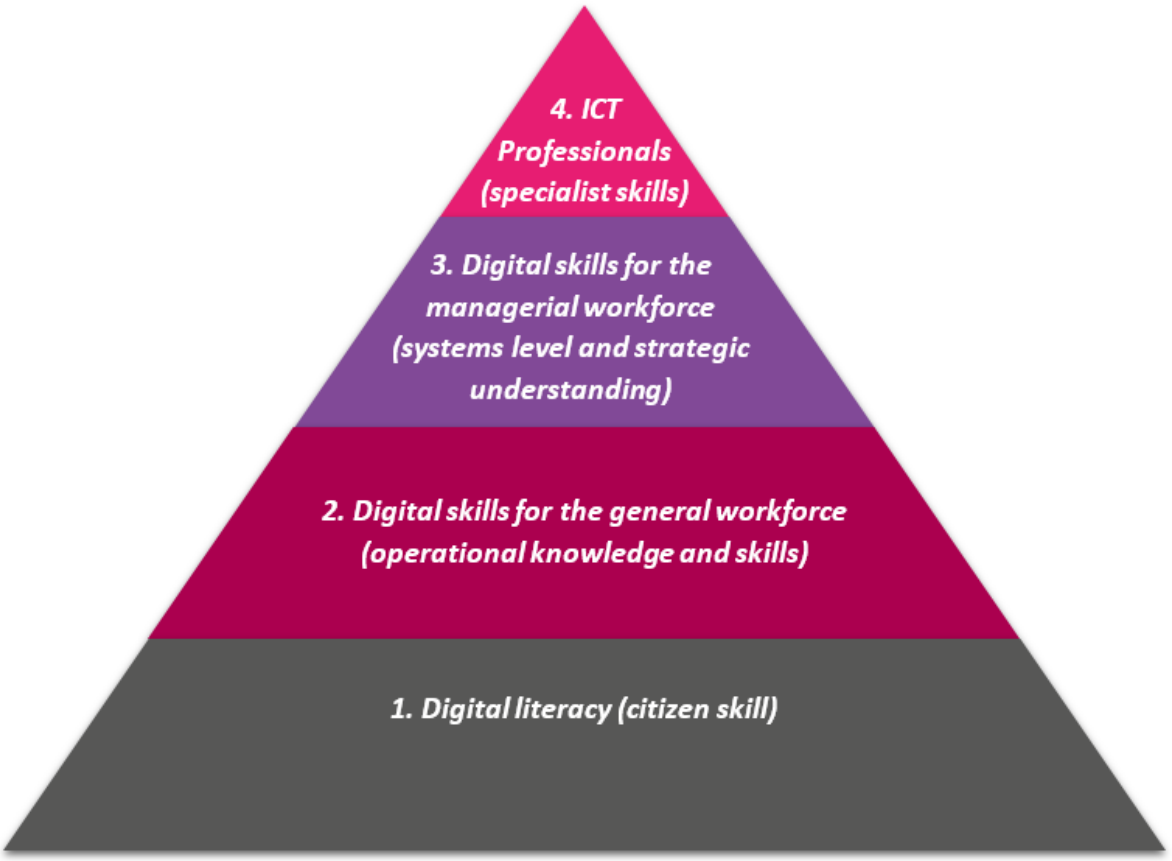

Figure 2: Digital Skills as a Spectrum in which the size of the pyramid block is relatively proportionate to the population size that should have the associated skill set [22]

The addition of an extra category (3) to the ECORYS division was deemed necessary to account for the types of digital skills needed by social and healthcare service managers, policy makers and others. These professionals need to understand the nature of, and be able to operate and make decisions within and around, the broader digital infrastructure in question. This tier is below skills needed for designing and building digital devices and infrastructures, but requires greater digital literacy than what is needed by the "general" workforce. While we recognise that the skills categories are more fluid than what this diagram details, the categorisation allows us to more easily discuss the different user groups and training needs within each of category. This is showcased below:

1. *Digital literacy* (empowering individuals – the bottom layer of the pyramid) is required by every citizen to become a fully 'digitally literate' member of society. This entails being able to carry out basic functions, such as using digital applications to communicate, to perform internet searches, whilst being aware of Cyber Security.

2. *Digital skills for the general (health and care) workforce* (an operational and practical skills category) includes skills within Category 1, plus those needed in the workplace, and generally linked to using applications developed by IT specialists. While digital skills needed by the workforce are likely to differ between sectors and from one job role to another, there will be some minimum requirements linked to processing information that is applicable across all domains and levels of seniority.

3. *Digital skills for the (health and care) managerial workforce* (consultants, social workers, management, policy makers etc.) include the skills within Categories 1 and 2, plus the ability to not only use, but manage digital applications and technologies, and understand them on a systems level, in order to make informed decisions about issues related to digital infrastructures. These digital skills may only be relevant to designated senior staff, but again there will be certain minimum requirements that are applicable across all areas of the Health and Care sector.

4. *Digital skills for (health and care) ICT professionals* (Digitally innovative and creative individuals, organisations and businesses) include all previous Categories, plus the skills required in the diverse IT sector. These include skills linked with design and development of new digital technologies, products and services, which are needed if the UK is to compete with other nations in relation to investment in digital technology and its utilisation. (Specialist skills, includes competence) [22].

2.4 Types of job roles within the Digital Health sector

The TechCity (2016) report categorises job roles within digital technology companies[II] into three types [23]:

1. Natives[III]: Digital jobs in Digital Technology industries (22% of the workforce); e.g. a front-end developer in a software company. (Category 4 in the Digital Skills Pyramid);

2. Supporters: Non-digital jobs in Digital Technology industries (37% of the workforce); e.g. a market manager in a Data Analytics company. (Category 3);

3. Transformers: Digital jobs in traditional industries (41% of the workforce); e.g. a data scientist in the public sector. (Category 4).

Within the Digital Health sector, "natives" could work in developing digital health software and apps, while "supporters" could be employed in the same company operating at the customer face, or they could be a healthcare expert required by a company producing health apps. "Transformers" could be, for example, data scientists or cyber security specialists working for a health board. It is notable that the largest category is the "transformers", which reflects the speed at which traditional workplaces are becoming digitised.

Consultation replies: Diversity of job roles within Digital Health

Job roles within the Digital Health sector are as diverse as the field itself, and very much related to the core business of the employer in question. Each employer named a wide range of job roles, ranging from software and hardware developers and engineers working at the back end of a product or service to implementation consultants and other support staff, who help the users – be it health and care organisations, or individual users – to make the best use of the digital service in question.

Job roles within Digital Health also include, for example: business analysts, senior managers, project managers; sales, marketing, finance and communications personnel; specialist nurses, clinical consultants, clinical directors; product owners, testers of quality assurance, user-experience people; graphic designers; support agents; librarians and knowledge managers.

[II] Digital Technology business provides a digital technical service/product/platform/hardware, or heavily relies on it, as its primary revenue source [23].
[III] Natives" could also encompass non-digital workers within a traditional industry, such as a healthcare worker at a health centre.

Chapter 3 Drivers for change: Why this new sector is emerging?

3.1 Global technological advances

Digitisation of healthcare has progressed over the last ten years through advances in digital technologies and genomics. While the internet, mobile networks, health IT and social networking form the basis upon which digital health and care can be built, the developments in mobile and wireless devices, hardware sensors and software sensing technologies, microprocessors and integrated circuits have taken the field forward [10]. Big Data and the Internet of Things (IoT) will play a significant role in digital health in the future, assisting, for example, clinical decision support systems, predictive analytics and innovations in population health. These technological improvements are rapidly transforming the world of work, with majority of organisations going through a digitisation process in terms of their service delivery models [1, 2, 3, 24, 25].

3.2 Scotland's ambition to be a leading digital nation by 2020

The Scottish Government's ambitious vision for Scotland is to be a world leading digital nation by 2020 [26, 27]. The drivers behind this ambition include the global move towards digital services in governance, finance and commerce; the exponential growth of IoT, rise of robotics, Artificial Intelligence (AI), machine learning, biotechnology and genomics [2, 4, 19, 26, 28-31]. By 2020, Scotland is envisaged to have a smart digital infrastructure that not only facilitates integrated health and care services across the nation, but also provides information processing, data analytics and decision support services for health and social care professionals to improve safety and quality of care [26, 29, 30]. The Scottish Government has recognised that it will be unable to deliver the 2020 vision. However, the realisation of this digital infrastructure should remain the primary goal for the Government for the foreseeable future.

3.3 An ageing population

Scotland's population is predicted to increase to 5.7 million inhabitants by 2039, representing a 7% growth since 2014 [32, 33]. In 2016, 18% of the Scottish population were aged 65 and over. This demographic is projected to increase by 53% in size by 2039, while the number of 85+ year olds is expected to double by 2034 [32, 33].

This steady growth in population is due to an increased life expectancy by virtue of multiple socioeconomic advances. The average person born in 2037 can expect to reach 82.0 years of age (for males) and 85.5 years (for females). By comparison, the average person born in 1981 can expect to live up to 69.1 years (for males) and 75.1 years (for females). However, a *healthy* life expectancy is not increasing as fast as the overall life expectancy, resulting in an increased need for health and care support particularly in the last few years of life

[32]. Overall, just 2% of the Scottish population accounts for 50% of NHS Scotland's total expenditure [35]. For example, there are currently an approximated two million people in Scotland who have at least one long-term condition [24]. Dementia affects currently 93,282 people, with an expected 40% increase in the prevalence of the condition across the UK by 2025 [36]. These demographic changes currently have and will continue to put pressure on public expenditure as well as on the demand for health and care services, including drug prescription, health treatments, transport, and other infrastructural issues [32].

3.4 Person-centred care

The Scottish Government has introduced a number of intertwined policy publications[IV] and strategies in recent years to ease pressure on the NHS and Social Care Services in Scotland. These are pushing the services to become outcomes-focussed and person-centred. The emphasis is shifting from reactive healthcare to prevention of ill-health, with a concentrated effort to plan and deliver quality services locally so long as they are clinically appropriate, while at the same ensuring people and communities are fully involved in their own care. All proposed changes seek to enhance patient safety, self-management, clinical effectiveness and person-centred care, suggesting the need for scalable service model redesign. Digitisation is a key enabler to support these changes [37].

3.5 Integration of the Health and Care sectors

The need to respond to a growing ageing population with increasingly complex needs, and the development of a more person-centred and efficient Health and Care Service, led to a policy shift towards the integration of Health and Social Care Services in 2016 in Scotland [11, 37]. This integration is still underway and has occurred in a sequential manner with iterative improvements over the past seven years. The plans for the integration of Scottish Adult Health and

[IV] The 'Social Services in Scotland' strategy for 2015-2020 identifies multiple areas for reform and transformation, including those linked to the integration of health and care, with increased focus on preventative and anticipatory care taking place in community settings, and improving outcomes and reshaping care for both older and younger people [16]. The 'Social Care (Scotland) 2013 act' placed greater emphasis on increased personalisation of services and implementation of self-directed support.
'National Clinical Strategy' is the most recent piece of legislation providing the guidelines for the all of Scotland's clinical services [30]. Building upon the NHS's 2010 'Quality Strategy' and the '2020 vision' of 2012, the strategy put forward proposals for how clinical services need to change in order to provide sustainable health and social care services that meets the goals of NHS Scotland and the Scottish Government (Social Care (Self-directed Support) (Scotland) Act 2013).
The intentions of this strategy have already cascaded into more specific aspects of healthcare, with the release of the Scottish Governments 'Modern Outpatient: A Collaborative Approach' [59]. This document allows for us to see how the desired changes to health and care can be achieved. By 2020 the programme aims for GP advice and decision making to be recorded in the patients record, there will be increased awareness of self-management, an integrated and holistic approach to patient management, and a redesign of the current referral model to ensure patients are getting the care they need and not undergo any unnecessary appointments [59].

Social Care were announced in December 2011 [38]. The legislative framework for the integration of Health and Social Care, the Public Bodies (Joint working) (Scotland) Bill, was set out in 2013 (Scottish Parliament 2016).

The Public Bodies (Joint Working) Act of 2014 established new public organisations known as Integration Authorities to try and break down barriers to the Health and Social Care services working together [39, 40, 41]. The Scottish Integrated Health and Social Care sector has a strong emphasis on digitally enhanced service provision. This includes switching from analogue to digital services in health and care, which is accelerating this drive, and is reflected in the refreshed eHealth Strategy [11], as well as the newly published Integrated Digital Health and Care Strategy 2017-2022[64]. The new strategy details a bold and enterprising approach to taking digitisation of health and care services to a completely new level in Scotland. Some preliminary information relating to the new strategy was provided in a preliminary publication (eHealth Scotland 2017), which demonstrated the technologies and services already in place in Scotland in the public sector, resulting from the previous 2011-2017 Digital Health strategy [42]. Examples of these are shown in Table 1, along with the benefits provided by each innovation.

The Digital Health sector, specifically the digitisation of the Integrated Health and Social Care sector, will be part of the solution to Scotland's Care sector problems. This digitally-enabled sector will require both the providers and the users of the services to have the essential skills to successfully take part in the digital future. For the providers, this means making the necessary resources available for up-skilling their workforce. The Scottish Government will need to promote changes across all levels of the Scottish education system to ensure that there will be a steady supply of skilled workers for the Digital Health sector, as well as that both citizens (users), and the future health and social care workforce have the sufficient digital competence to interact with what this sector has to offer.

Name of Innovation	What is it	Description	Benefit Provided
No Delays	Electronic postcard	Gives health professionals the ability to prescribe and send patients personalised digital packs with specific video clips and information customised to their needs; allows for a follow up from appointments, providing the potential to improve patient understanding and the doctor-patient relationship during and after consultation.	Citizens have access to the digital information, tools and services they need to help maintain and improve their health and wellbeing.
My Diabetes My Way	Interactive website	Helps support people with diabetes and their carers. Contains leaflets, videos, educational tools and games with information about diabetes. Website allows the citizens an access to view up-to-date diabetes clinic results, helping to manage your condition more effectively.	Citizens have access to the digital information, tools and services they need to help maintain and improve their health and wellbeing.
HEPMA	Hospital electronic prescriptions and medicine administration programme	A project to implement a unified hospital electronic prescribing and medicines administration system (HEPMA) in Crosshouse Hospital. Undertaken in 2014.	Citizens' health and social care information is captured electronically, integrated and shared securely.
Glasgow Cardiovascular E-Registry – An evaluation of NSTEMI care pathways and outcomes	Integrated patient records	This project aimed to link patient records across multiple systems to develop a near real-time e-registry for patients with suspected acute coronary syndrome (ACS).	Digital technology and data will be used appropriately and innovatively to help plan and improve services.

Table 1: Examples of digital health technologies and services in the public sector in Scotland.

Consultation replies: Drivers for change

Most businesses and organisations we consulted with reported that their sectors are growing or expanding, and most consultees were currently, or had recently been recruiting new staff. Key drivers for expansion of the sector include the general digitisation of services, including the staff development provision, and changes in technological development, such as the arrival of cloud computing and machine learning.

The integration of the Health and Social Care services was mentioned as the main policy driver affecting the growth of digital health businesses and organisations. Additionally, integration has increased the need to improve communications between the services, as has the volume of data generated following the digitization of services.

The recent Scottish Government eHealth strategies and the new Integrated Digital Health and Care strategy are moving the emphasis of care away from acute services to communities, supporting the growth of digital health services and businesses in Scotland.

Strategic decisions made by the Government and larger organisations to support digital transformation are another central factor in expanding the market. The Once for Scotland and Digital First approaches were named as key drivers among them. These strategies allow for sharing of resources (such as APIs, technology and learning resources, etc.) between organisations. This reduces cost, duplication and supports centralisation and standardisation of learning resources and systems across the NHS and the Social Care services.

Chapter 4 Digital Health Market

4.1 Exponential market growth of the Digital Technology sector

The Digital Health sector nests within the wider Digital Technology sector, which is one of the fastest growing economic sectors in the world. The global Digital Transformation[V] market was valued at $150 billion in 2015 and is predicted to increase in value to $431.7 billion by 2021 growing at 19,2% Global Cumulative Annual Growth rate (CAGR) between 2016-21[43]. The global Digital Health market is predicted to grow at an even higher rate at a 25.9% CAGR to 2024, exceeding a value of $370 billion by 2024 [44]. The UK market size for Digital Health in 2015 was £2 billion, was expected to reach £2.9 billion in 2018.

In the UK, the Digital Technology economy[VI] was creating jobs 2.8 times faster than the wider economy in 2016, and still twice as fast as the rest of the economy in 2017 [23, 45]. The same trend is evident in Scotland, where the Digital Technology sector is the fastest growing economic sector over all, predicted to expand twice as fast as the rest of the Scottish economy until 2024 [8, 9]. The number of Digital Technology businesses has increased by 53% since 2010 in Scotland, employing currently over 60,000 people in total. The demand for ICT specialists is high, which is exemplified in the need for computer consultancy having increased by 72%, and for programmers by 152% since 2010 [8]. In 2015-16, 90,000 people were employed as technology professionals across *all sectors*, accounting for 4% of the national workforce in the country. Approximately 60% of the workforce was employed in technology roles and 40% in other types of jobs [8, 9]. In 2015, the sector contributed £3.9 billion Gross Value Added (GVA) to the Scottish economy [8]. The Scottish ICT sector is projected to require 12,800 new employees per year until 2020 to satisfy the need for a sufficiently skilled workforce [9]. The Scottish Government ambitions are even higher in that their aim is to create 150,000 new digital technology roles across Scotland over the next five years [46]. The UK-wide prediction is for 1.2 million new technically and digitally skilled people to be required by 2022 to meet the future skills needs [47]. The expansion of the Digital Technology sector is creating significant employment opportunities for skilled workers, young people and other new entrants to the field [9]. These trends are also reflected within the Digital Health sector.

[V] Digital transformation market refers to the use of digital technologies such as cloud computing, Big Data, social media, mobility, analytics, and more – all key components of digital health - to improve or add more features to their traditional business processes and also to maintain customer relationships. Digital transformation is the outcome of changes that occur with the application of advanced digital technologies [43].

[VI] TechCity defines digital technology business as one that provides digital technical services / products / platforms / hardware, or heavily relies on these, as its primary source of revenue [23].

Consultation replies: Factors affecting growth

Digital Health business growth is constrained due to lack of a higher skilled workforce. Business is also affected by restrictions within the NHS procurement system, while some SMEs find the Scottish innovation landscape “vested”. They find it is hard for an SME to make their voice heard within the Scottish business terrain: “The hardest thing is finding the right people in the right room at the right time to demonstrate what you can do”.

While larger organisations, such as the NHS, might benefit from having digital development work carried out in-house, this can take work away from smaller SMEs. However, at the same time, this creates lots of new jobs for people with digital health expertise in the public sector.

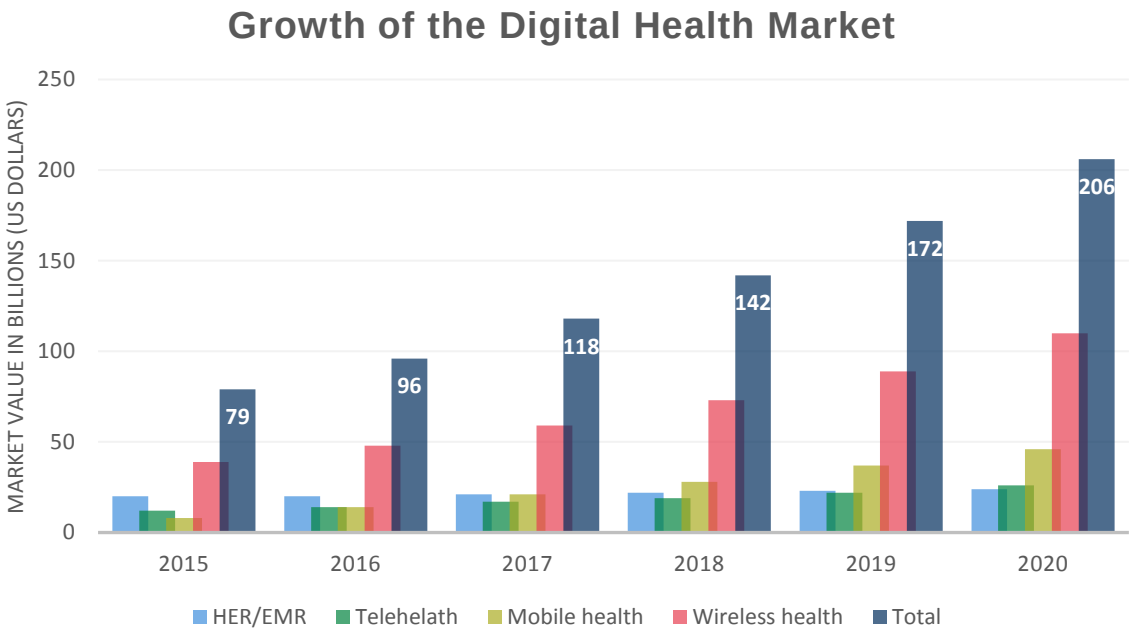

Figure 3: The growth of the Digital Health Market. Adapted from Statista [48].

Figure 3 displays the global Digital Health market by major segment[VII] in 2015 and 2016, with a projection from 2017 until 2020 [48]. Statista valued the global Digital Health market at $80 billion in 2015, expecting that it will exceed $200 billion by 2020. This growth will be driven primarily by the mobile and wireless health markets [48]. According to Deloitte, on the other hand, the global market for Digital Health in 2014 was worth £23 billion and was expected to almost double at £43 billion by 2018 [49]. The global CAGR for Digital Health is at 18%. The differences in the figures are most likely down to divergent definitions of the Digital Health sector used by the evaluators. With this in mind, it is useful to view the individual sectors to

[VII] The way that the Digital Health sector is segmented varies from one source to another.

get a clearer picture of the Digital Health market, rather than the composite view used by market evaluators such as Statista.

mHealth

The fastest growing and most promising sector of market both globally and locally is Mobile Health. The mHealth app market is predicted to grow at 35% CAGR per annum in the UK, and 49% globally during 2014-18. Deloitte Centre for Health Solutions predicts Europe to become the largest mHealth market worth $7.1 billion with predicted annual growth of 61.6%, but Statista has pointed to the Asia-Pacific region as the main growth area for this market [48, 49]. This emerging market is expanding due to high consumer demand, and common prevalence of smart phone ownership. For example, in 2014 the smart phone penetration in the UK reached 70% of the population; there were over 100k health apps available for smart phones, and 75% of the population reportedly go online in search of health information [49]. The wearables market expanded at 24% CAGR in the UK, and at 21% globally. However, monetisation in the market is being restricted due to the absence of a clear reimbursement model and possibly the lack of clinical approval. This is not a problem only in the NHS, but also more widely throughout the EU. [48, 49]

Digital Health Systems

The largest of the four sectors in the UK is Digital Health Systems, with a 66% share of the market. This includes electronic health records (EHR) and e-prescriptions, and a total existing market size of £1.3 billion. The UK is a global leader in the sector thanks to the early adoption of primary care electronic health records, but the adoption has been slower in acute hospital settings. The market is fairly saturated, and the market share is only predicted to grow at 6% CAGR in the UK and at 7% per annum globally by 2018. The market can be accelerated through incentivising the use of EHR-platforms, by investing in interoperability between systems, and in cyber security in order to move data securely between organisations. Attention is also needed on safe storage of confidential data, data linkage and reliable analytical practices for supporting clinical decision making [48, 50].

Telecare and Telehealth

Telecare is the second largest sub-sector of the market, contributing 13% of the UK Digital Health market. This sector is mature, and well-established, thanks to the UK being an early adopter of telecare with strong central Government backing. This has created a steady infrastructure of existing hardware supporting the adoption and use of telecare. The UK Telecare market is predicted to grow by only by 4-5% CAGR by 2018 [12, 49, 50].

In comparison to Telecare, Telehealth – the remote exchange of clinical data between a patient and their clinician – is not as well-established a market in the UK, remaining more dynamic and faster growing than Telecare. The worldwide Telehealth industry is forecast to grow from approximately

£700 billion in 2014 to £1.2 billion in 2018, showing a CAGR of 13-14%. In the future, Telehealth and Telecare will start to merge with mHealth Apps market, which will become increasingly segmented by the apps' target audience (consumer vs. professional) [12, 50]. It is important to note that within the next decade, telecommunication systems across Scotland will have to make the move from analogue to digital, as analogue systems will gradually be taken offline and no longer supported by the Telecommunications sector.

Health Analytics

Health Analytics is also an emergent and fast expanding market in the Digital Health sector. The growth prediction is at 24% CAGR in the UK, and 22% globally by 2018. The UK is being hindered from becoming a world-leader in this sector due to shortages in relevant skills and capabilities (e.g. staff with data analytic and data science skills), issues with access to data and data governance challenges [12, 50].

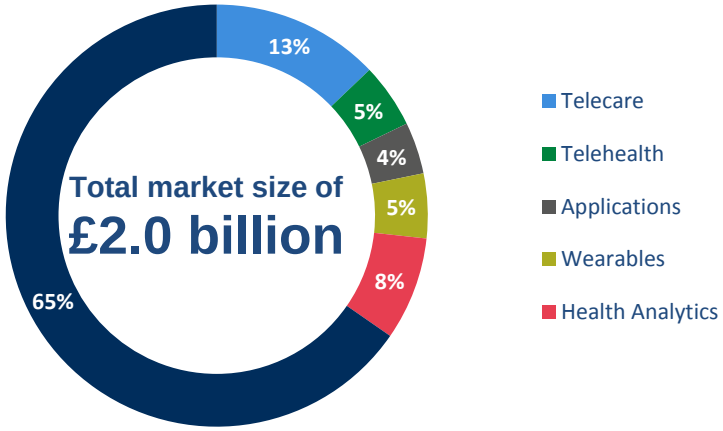

Figure 4: UK Digital Health Markets. mHealth has been divided into Wearables and Applications. Adapted from Deloitte 2015, p. 8 [12].

4.2 The job market in the Digital Technology and Digital Health sectors

In 2016, the Digital Technology sector accounted for 1.56 million jobs in the UK, and for 1.64 million in 2017. Over 60,000 people are employed in technology businesses across Scotland, making up 2% of the national workforce. Almost two thirds of this workforce hold technical roles. The number of people choosing to work in digital technology businesses has grown in the central belt of Scotland in recent years with Glasgow and Edinburgh seeing 36% and 19% increases respectively. The number of technology professionals employed in other industries is growing faster than those employed within technology businesses themselves, this illustrates the demand for digital skills across Scotland and the importance of digital

technology professionals for the economy [8].
The average salaries within the Digital Technology sector were 36% higher than the UK's national advertised average in 2016, and 44% higher in 2017 [23, 45]. A similar trend is visible in Scotland with an average Technology sector salary being at least 30% higher than the Scottish average and growing at a faster rate than salaries in other sectors [51].

According to Deloitte, there are over 60 private sector companies in the UK providing services that *include* Telecare and Telehealth services, and which employ a total of 7,000 people [12]. However, only two thirds of the companies specialise explicitly in Telehealth and Telecare. The total number of employees involved in delivering Telehealthcare services is less than 2,000 people from fewer than 20 companies across the UK. Approximately, 8% of these are based in London, with 5% being based in Edinburgh. The majority of the rest are the only business in their locality [12].

At the same time, Company Connecting have listed 139 IT companies active within the Healthcare sector in Scotland [17]. The majority of these (77) are located either in Glasgow or in Edinburgh, where the strongest growth has taken place [51]. Most of these companies are either small or medium size employing just two to five, or 20-49 staff, reflecting the trend across the UK [9,12,17, 51]. According to the report by Scottish Development International, companies with specific focus on Digital Health and Care in Scotland employ a total of 7,000 people [52]. Again, differences in numbers reflect the varying way that the Digital Health sector has been defined[VIII].

4.3 Digital Health within the Public sector in Scotland

The integrated Health and Care workforce in Scotland stood at approximately 366,000 staff[IX] in 2016, accounting for circa 12.5% of Scotland's entire workforce, making it the largest employer in the country[X] [32, 53, 54, 55]. Digitisation is starting to have a major impact on the workforce even within the Public Health sector in Scotland, as the Government is looking to digital technologies as a solution to the strains and issues affecting the sector[XI]. While the vast

[VIII] Company Connecting was looking speficially at IT companies active within the Digital Health sector, while Deloitte (2015) divides the sector into four areas: Telehealthcare, mHealth, Health Analytics and Digitised health systems. For a more detailed description, see above p. 17-18 [17, 49].
[IX] NHS Scotland employed 162,598 people at the end of 2016 (full-time equivalent) [32, 55]. 4,7% of the workforce belong to the NHS and 7,8% to the social services [53, 54].
[X] The Ekosgen 2016 report, p. 21, estimates the numbers at 408,000 employed in the integrated health and social care sector in 2014, representing 16% of the total employed workforce in Scotland, making it the largest employment sector [32].
[XI] The increasing ageing population in Scotland that lives longer with more long-term conditions means that the need for health and care services continues to grow. Between 2009 and 2014 there was an overall increase of 5% in employment in the sector, which was above the average across the different sectors. At the same time, as the Scottish workforce ages, the tax base needed to fund the health and care provision is narrowing: the dependency ratio in Scotland is expected to increase from

majority of the Health and Care professionals are employed in non-digital roles within the traditional sector, every job role increasingly requires the ability to work in a digitally-enhanced way [30].

There are a number of agencies in Scotland that have been working in Digital Health for years. These include, for example, NHS24, Scottish Centre for Telehealth and Telecare (SCTT) and Technology Enhanced Care group.

NHS 24

NHS24, a specialist Health Board established in 2001, is the national Telehealth and Telecare organisation in Scotland. It provides an out-of-hours telephone and online advice and triage service for the NHS.

Scottish Centre for Telehealth and Telecare

The Scottish Centre for Telehealth and Telecare (SCTT) is a part of NHS24, and works closely with the Technology Enhanced Care group to support the development and expansion of technology enabled health and care services in Scotland. SCTT works closely with a wide range of collaborative partners from the different sectors of society (NHS, health and social care partnerships, academia, third sector, industry, etc.) to redesign health and care services.

The main strands of work currently include supporting self-management, home and mobile health monitoring and provision of computerised cognitive behavioural therapy services. SCTT also supports a range of innovative services and projects across Primary and Secondary Care, ICT Infrastructure and Workforce Development.

Technology Enabled Care Programme

The Technology Enabled Care (TEC) Programme was launched in 2014 as a three-year £30 million Scotland-wide programme to align with the existing National Telehealth and Telecare delivery plan. In 2017, the programme was aligned with Scottish Government's eHealth strategy. The aim of the programme was to improve the health outcomes of individuals in home or community settings through the application of technology as an integral part of quality cost-effective care and support.

The work of the TEC programme included:

- **Expanding home health monitoring** as part of integrated care plans across Scotland. This is being led by the Scottish Centre for Telehealth & Telecare (SCTT);
- **Expanding the use of video conferencing** to enable partner organisations across all Health and Social Care sectors to participate, and growing its use for clinical/practitioner consultations;
- **Creating a national digital platform framework** to expand the availability

58 per 100 population of working age to 67 per 100, based on population projections of 2014 [32].

of supported self-management information, products and services for Scottish citizens;
- **Expanding the take up of Telecare**, with a particular focus on upstream prevention, support for people at transitions points of care and people with dementia and their carers;
- **Exploring the scope and benefits of switching current provision of telecare from analogue to digital telecare**

Scottish Health Innovations Ltd.
Scottish Health Innovation Ltd. (SHIL) is a private company working in partnership with NHS Scotland to identify, protect, develop and commercialise healthcare innovations to improve patient care. SHIL was formed in 2002 with three shareholders: The Chief Scientist Office, NHS Tayside and the Golden Jubilee Hospital. The main aim of the company is to help bring new ideas and innovations from healthcare professionals to life. SHIL offers skills development for innovation, including assessing ideas, product development and prototypes, protecting intellectual property rights, raising funding, marketing, commercialisation and entrepreneurial skills.

British Computer Society Health Scotland (BSC Health Scotland)
British Computer Society Health Scotland is an academic, multi-professional group that promotes the development and use of Health Informatics in Scotland. Their aim is to support effective, evidence-based, efficient health and social care in areas of research, education, practice and management decision making.

Farr Institute
The Farr Institute is a UK-wide research collaboration, which involves 21 academic institutions across the country, and focusses on health informatics research. The institute is publicly funded by a consortium of ten organisations led by the Medical Research Council, and committed to delivering high-quality, cutting-edge research using Big Data to advance the health and care of patients and the public. The Farr Institute does not own or control data but analyses data to better understand the health of patients and populations.

Apart from pioneering interdisciplinary Big Data research, the Farr Institute works with skills development for the health informatics community and carries out public engagement to demonstrate the benefits of using health data in research. The institute also works to develop new methods, technologies and standards for health informatics research, creates partnerships between the Government, public sector, academia and industry, and works with the owners and controllers of data to support safe use of patient information for medical research in the UK.

The Farr Institute at the University of Edinburgh is also a member of the Digital Health Academy in London.

Scotland's Innovation Centres
Three of Scotland's innovation centres focus or participate in developing digital health and care in Scotland:

- **Digital Health and Care Institute** works with strategic Digital Health SMEs across Scotland to meet the demands articulated by the Scottish Government. We work closely with the NHS and decision makers within the Government to implement positive changes to service redesign allowing for truly person-centred care. The main areas of focus surround citizen-centred data sharing; next generation connectivity through emerging technology, supporting skills development of the future workforce for health and care in Scotland, as well as service redesign of modern outpatients, gastroenterology and diabetes services.
- **The Data Lab** also brings together industry, public sector and universities to unlock the power and value in Big Data. Big Data is vital for the development of healthcare and will become increasingly more important with more data is utilised for research and service redesign purposes within the health and care sector.
- **Stratified Medicine Scotland** works with relevant bodies in the private and public sectors to promote the adoption of precision or personalised medicine. This is imperative to the expansion of digital health as healthcare will evolve to become ever more personalised through the use of genetic testing and predictive analytics.

In addition to the organisations specifically driving digital health and care forward, there are many more private and public sector healthcare entities that are working in collaboration with the aforementioned specialist organisations. These collaborations aim towards the implementation and scaling up of different digital health and care solutions.

Chapter 5 Skills required in the Digital Health sector

5.1 Skills in an interdisciplinary sector

The Digital Health sector, by its very nature, is an interdisciplinary field. This is reflected in the range of skill sets required of the workforce as identified by Scottish IT companies operating in health and care [17]. The top ten skills identified were:

1. Software Development
2. Project Management
3. Bespoke Software
4. App Development
5. Mobile Applications
6. Business Analysis
7. Cloud Solutions
8. Data Management
9. Web Design
10. Business Intelligence

By far, the most sought-after skill within the Digital Health sector is *software development*, followed by project management, bespoke software and app development skills [17]. Software development was identified as the most crucial skill within the Digital Technology sector as well. Additionally, according to Digital Scotland review from 2016, 70% of the employers named software development and implementation skills as the most common skills category they were recruiting for in the previous year. Most employers were seeking to fill experienced and technical roles.

The second most important skill set for the Technology sector in general was in sales & marketing (66%) [56].

Digital Health companies also require people with business analysis and cloud solution skills, skills for data management, web design and business [17]. Interestingly, knowledge or understanding of healthcare issues does not feature on the list.

In the general Digital Technology sector, software development and marketing skills were followed by strategy and architecture skills (34%), business change management skills (29%), service management (28%), data skills (27%), and procurement and management (22%) [56].

Out of the programming language skills employers require, HTML and Java top the list, with 25% of the employers stating they valued the ability to learn various programming languages over developing language specific skills (see Figure 5) [56].

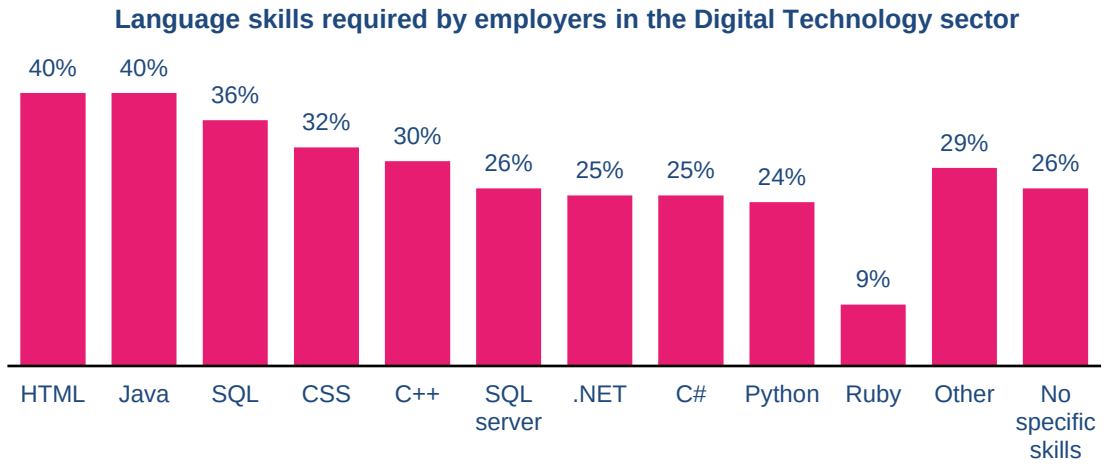

Figure 5: Language skills required by employers. Adapted from Digital Scotland, 2016, 33 [56].

Digital Skills for Health Professionals report by the European Health Parliament (2016) lists the following overall digital health related skills required of healthcare professionals. In Figure 6 we have contrast these with the aforementioned digital skills spectrum (left pyramid) [57].

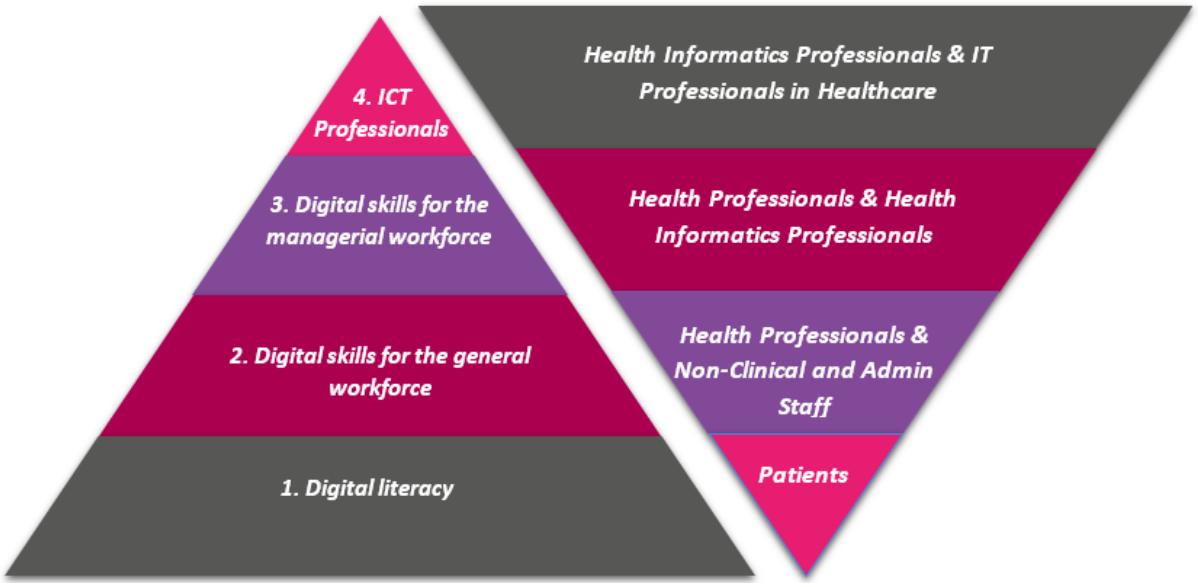

Figure 6: Digital skills spectrum. Out of these, 2) and 4) fall within the Digital Health sector skills, and reflect the needs detailed above.

Consultation replies: An interdisciplinary field requires an interdisciplinary set of skills

The skills required in the Digital Health field listed by our consultees largely reflect the findings by Company Connecting (2017) and Digital Scotland (2016). However, our consultations found that the *hardest skill combination* to find was computer science expertise combined with an in-depth knowledge of the Health and Care system.

> *"The Scottish market is not stagnant but is very bounded. Intersecting IT with healthcare actually leaves you with quite a small cohort of people to pick from. There doesn't seem to be a massive influx of people and expertise coming into that pool. So, I do think that this is a challenge for us right now."* (Large Digital Health SME)

Software skills: The most difficult professional group to recruit are people with software skills **-** software engineers and software developers. A common recruitment issue among the Digital Health employers across the public and private sector was their ability to offer competitive graduate salaries to attract the right calibre graduates with the relevant skills, as well as the right kinds of values. Given the small numbers of software engineering graduates in Scotland, the salary expectations tend to be driven up, while graduate skills often do not match the employers' expectations. Many Digital Health employers reach out to other sectors to recruit staff, training their personnel in-house. Given the pace of technological change, a broader understanding of software development, having the ability to learn new techniques and adapt into new ways of working was seen as a more valuable asset in an employee than having graduates trained in specific software techniques.

> *"We have a very highly skilled team which I have worked to upskill in the software skills that I need them to have to do this. Software engineers coming out of university expecting double my team salary causes a lot of friction, especially when they don't have half of the expertise that my team possesses. Therefore, we like to take on undergraduate software engineers before they know they are very talented. The interns that we have taken on have come back to us summer after summer because they enjoy the work here even though they could get higher pay elsewhere."* (Small Digital Health SME)

> *"There's a lack of software skills still in Scotland. Software engineers are difficult to attract and quite often don't have the values that I anticipate".* (Small Digital Health SME)

Business and Entrepreneurial skills: SMEs also highlighted the importance of understanding how to run a business, and suggested business and entrepreneurial skills as an area for upskilling or additional training for their staff. This was also suggested as something that should be embedded in computer science courses at universities and colleges. Increasing the number of industrial placements as part of undergraduate training was highlighted as a way of exposing the students to real-world issues and allowing them to gain real-world experience in the relevant fields.

Change Management: Staff with skills in change management were also sought after to manage and support the transition brought forth by digitisation, specifically in the traditionally non-digital sectors.

Infrastructure Engineering: A spokesperson from a small Digital Health SME, which focusses on Telehealth said they found it difficult to attract senior technical staff - specifically infrastructure engineers - with at least 10 years' experience. These staff are being recruited from all different types of industry, but as a small company it is hard to compete with larger businesses to attract such experienced staff, especially given the small pool of potential employees that meet their criteria.

> *"The senior technical people would be infrastructure engineers – we like to hire people who have at least 10 years IT experience who can give expertise support. They don't have to come from any particular sector as long as they have the transferable skill set to do the job we require, then that's okay. We have found that the IT sector is very transferable anyway so that's good. In terms of developers, we like to take on mainly senior people. However, there isn't a good pool of people to pick from which makes recruitment challenging."* (Small Digital Health SME focussing on Telehealth)

Data Science: A skill set in short supply is the ability to work with Big Data: data science and data analytics. The need for staff with these skills is on the increase, especially within the public Health and Care sector. Most courses in Data Science in Scotland are on postgraduate level. The spokesperson for a Research Institute specialising in data linkage in healthcare said that while the number of Data Science courses is increasing, and many healthcare professionals would be interested in data science, there is a lack of courses catering for a variety of interests. Unclear career pathways for Data Science graduates was noted as an issue putting potential students off.

Software Testing: While a larger, more traditional Digital Health Software Development Company has had no difficulties in recruiting software testers, the situation is quite the opposite to a Public Healthcare Organisation. This was down to the adoption of agile delivery method in software development by the organisation, which meant that the traditional software testing methods have changed. As the spokesperson for the organisation explained:

> *"There are emerging methodologies such as exploratory testing, which is more targeted testing, and which fits in with delivery pressures. Advertising and recruiting for software testers has been very difficult even within the contract recruitment pool. The testers generally aren't experienced in this new emerging methodology - they are used to working in the old way."* (Special NHS training board)

5.2 Future trends and future skills required in Digital Health and Care

Consultation replies: Future trends in the sector

Digitisation: The companies and organisations that we consulted foresee digitally enabled working becoming a norm in the next five to ten years. This has implications not only for the Digital Health sector but for the Health and Care sector as a whole. For example, digitisation of health and care data will become more automatic and a common practice.

Precision Medicine: The importance of data and genomics, especially the rise of precision medicine, is going have the biggest impact on healthcare in the next five to ten years according to our consultees. Medicine will become more predictive, focussing on prevention of illness, and on supporting people living independently in the community. This development will be enabled by data becoming more interoperable and actionable through better structuring. Machine learning and AI will help with automation of certain services, and in making the date more useable. The use of aggregated data will become a common practice. These developments mean that demand for data analytics and data science skills will increase exponentially.

> *"We think that genomics and how they influence precision medicine will become a very interesting phenomenon in healthcare which we wish to lead on Scotland. The use of precision medicine will be the biggest change in healthcare over this period. Genomics is going to revolutionise healthcare and our company want to be at the forefront of this change."*
> (Large Digital Health SME)

Culture change: Scotland needs to undergo a culture change to allow for Digital Health to become mainstream and start reaping actual benefits that data offers. Companies see a strong expansion of the Digital Health and Care market, with more and more businesses emerging in the sector. Having said that, for the expected market expansion to materialise, one SME pointed out:

> *"There needs to be a cultural change within NHS Scotland, public sector and the general population, where they understand that innovation can happen on your doorstep as well as having an excitement about entrepreneurship and where ideas are encouraged". (Small Digital Health SME)*

The review of Scotland's Digital Technologies found that employers in the Technology sector do not expect the current skills requirements of their staff to change much in the future. Rather, the existing requirements for software and client interface skills, data, sales and marketing skills will

become increasingly more important for technology businesses. The biggest issue facing these businesses was deemed to be the ability to recruit people with the right technical skills or experience (79%). According to the review, over 60% of employers stated that the most significant issue affecting growth of their business in the past 12 months was not having the right technical skills available within the organisation [8]. Furthermore, based on the analysis of how the Digital Health market is expected to grow in the next few years, it is indicated that the need for staff with skills in data analytics, population health, cyber security, genomics and precision medicine, mobile health and wearables, clinical decision support tools and cloud solutions will increase. Deloitte (2015) lists the lack of commercialisation skills, and shortages of IT and analytical capabilities as the key factors restricting the growth of the Digital Health sector. [12]

Consultation replies: Future skills needs

Willingness and ability to learn and re-learn will become vital in the digitally enabled work environments. Statistical and data science skills will become very important and more prevalent in the next five to ten years. Technical skills such R and Python will be a more sought after skill set, according to a Larger Digital Health SME.

> *"I think data analytics will be a huge part of the Health sector of the future and I think we need people who understand elements like security, identity, authorisation - these sorts of aspects which will be hugely important for a digitally enabled health service."* (Large Digital Health SME)

A small SME focussing on Data Sharing suggested better software development techniques and a broader software development toolkit will emerge to meet the needs of the future Digital Health and Care sector. However, a special NHS Training Board which operates within Digital Health predicts that with the adoption of cloud-based platforms, employees won't be required to have a large range of skills but rather they will need more specific and system focussed skills.

Chapter 6 Existing supply of skills - education and training in Digital Health

In the previous chapters, we have identified some of the core skills required by the Digital Health sector, as well as skills the employers envisage the field to need in the future. The requirements reflect the interdisciplinary nature of the domain.

The majority of the required skills are found in the field of computer sciences: software engineering, software development, infrastructure engineering, software testing, etc. Other skills relate to customer services, change management and business skills. However, as mentioned before the hardest skill set to find in potential employees is expertise in both computer science and the Health and Care services. With this in mind, it is still important to note that in the commercial side of Digital Health the required skills skew heavily towards computer science proficiency.

6.1 Computer Sciences

Computer science skills – software engineering and development, infrastructure engineering, etc. – are the most sought-after skills within the Digital Health sector. Together with technology and mathematics, computer science makes up about 69% of job roles filled within the Digital Technology sector.

Computing science is taught at 15 out of 19 Scottish Universities with 14 also delivering postgraduate programmes. There are computing science related courses on offer at 23 colleges in Scotland across all thirteen college regions. In 2014/15 there were 15,000 enrolments in Computing courses in Scotland. Computing science largely attracts male students: 71% of university Computing entrants and 62% of the college Computing entrants are 24 years old or younger; 75% of Computing Science students are male [8, 31, 58]. Women are also underrepresented in the computing workforce: just 18% of technology roles are occupied by women [8]. To contrast this, the majority of the health and care staff are female: according to NHS Employers (2017), 75% of the NHS staff are female, with just 5% working as doctors and dentists [60]. Just 11,4% of nurses are male [61]. In the Care sector, the gender imbalance is tipped for 84% female workforce [62]. If Digital Health and Care was taught more broadly as a subject on its own right, it might attract both male and female students given its alignment both with computing and health and care subjects.

In 2015, there were 4,381 Computing Science graduates in Scotland, which is a 5% increase from the two previous academic years. Between the 2012/13 and 2015/16 cohorts, the total number of Computing Science enrolments increased by 20% in Scotland [8]. Despite this rise in Scotland the number of students applying to study Computing Sciences at university level in the UK has plummeted since its

peak in 2002/03 at 41,000 entrants down to 19,000 in 2014/15 [57].

The highest numbers of enrolments in Computing Sciences at colleges are in Glasgow (20%), Highlands and Islands (15%), Aberdeen and Aberdeenshire (13%), West (12%) and Edinburgh 10%. While the overall numbers of students studying computing science at colleges has declined, this is primarily at the lower qualifications level (SCQF 5 and below). The number of students studying computing sciences in colleges at higher levels (SCQF 6-12) have remained largely the same. In terms of the pipeline of students enrolling to study computing sciences at both universities and colleges, in 2016 there was a total 14,212 passes in computing at SCQF 3-7 levels (from National to Higher and Advanced Higher exams) across Scottish secondary schools [8].

Skills supply and demand do not meet

Currently, the UK supply of specialist computer science skills is well above the EU average. However, despite the exponentially growing need for staff with digital skills across all sectors, the unemployment rate of Computer Science graduates remains the highest out of all degree courses. In the UK unemployment among Computer Science graduates was at 13% following six months after graduation [47]. In Scotland, the unemployment rate was higher at 29% among university Computer Science graduates, and 91% among the college Computing graduates. Although most of the college students went onto further study, which indicates that employers are looking for people with higher level qualifications and more in-depth skills in computer sciences [8].

The high levels of unemployment amongst Computing graduates points to a mismatch between the skills being developed in computer science curricula and what potential employers are looking for [47, 58]. The reasons for this mismatch may lie in the nature of computer sciences as a subject. Computer sciences is a broad disciplinary heading, which spans wide curricula and number of disciplines. This means that while students studying computer sciences develop a broad range of skills, they may not be developing the specific skill sets required in the specialised fields like Digital Health. This finding is supported by the Shabolt review (2016), which found that the employment landscape for computer sciences is very heterogeneous due to the wide applicability of IT and computing across all sectors of the economy [58]. Furthermore, SMEs and large corporations, and public and private sector employers have divergent skills requirements for their staff. This diversity amongst employers also affects staffing requirements within the Digital Health sector. The Shabolt review further points out that the computer science landscape is rapidly changing with the rise of cloud computing, cyber security, Big Data, data analytics, and mobile technology [58]. The challenge for the Higher Education sector is to successfully provide up-to-date, agile and relevant

content, which meets the needs of the industry, whilst also securing a common core of essential knowledge in the computing courses [58]. Employers in the Shabolt review, like in our consultations, found that graduates often lack work experience, commercial awareness, soft skills and had an insufficient technical knowledge. Soft skills refer to an individual's ability to operate well within a team in the workplace. This also showcases the gap between the supply of and demand for skills. A key finding from the Shabolt review is that students studying on "sandwich" courses – those that offer a period of practical work experience in between periods of theoretical study – enjoy the lowest levels of unemployment. The report stated that 6% of students who took "sandwich" courses remained unemployed in comparison with 15% of those who studied on an ordinary computer science course [58]. These graduates are also twice as likely to earn £20K as a starting salary in comparison to those with a standard degree. The same phenomenon applies to students on master's programmes, among which "sandwich" courses are very rare. Currently, at least Aberdeen University and the University of Strathclyde offer MSc Courses in Computing with an industry placement period. Skills Development Scotland has also introduced Graduate Apprenticeships. These are available in Digital technologies.

While the numbers of students entering computer sciences courses has fallen in the UK, the demand for people with computer science skills continues to grow. This means that those graduates who manage to gain employment are more likely to be in a well-paid graduate level job.

Consultation replies: Variance of routes into the sector

Employers identified multiple routes into employment, including university undergraduate and postgraduate recruitment; college graduate recruitment; Modern Apprenticeships; Graduate Apprenticeships; undergraduate placements; internships and traineeships; college placements; secondments and contractual work; transfer of computer scientists from other fields; and in-house upskilling of current staff.

> *"The courses at university need to embed an entrepreneurial attitude into their courses so that graduates can flourish in the industry and employers need to understand and appreciate that these graduates may start their on business one day and employers shouldn't be afraid of that. EEE = embedded entrepreneurial experience is fundamental". (Smaller Digital Health SME)*

Consultation replies: Variance of routes into the sector continued…

> *"I think that schools, colleges and universities need to be engaging with these SMEs much more to give students and young people the exposure to digital health at a young age to inspire them into this sector. The young people need to understand what they're trying to do, and what better way there is than to show them a real-life COPD system in action with real patients so that they see what the software can achieve and how. Companies could be going to schools and showcasing tech and software to children to get them interested in this filed." (Small SME focussing on Telehealth)*

6.2 Digital Health training in Scotland

Education and training specifically in Digital Health is in very short supply. A review carried out by the DHI in 2016 (unpublished) showed that the provision of Digital Health education was only available at a postgraduate level in Scotland. There are currently three taught MSc courses in the field of Digital Health across Scotland's 19 universities. Out of these three, only the University of Strathclyde currently hosts a fully focussed Digital Health master's - MSc in Digital Health Systems. University of West of Scotland host an eHealth MSc that focuses on educating students in eHealth and healthcare systems expertise. The MSc in Global eHealth at the University of Edinburgh focusses on human and organizational influences on technology adoption, evaluation of Digital Health innovations, as well as on drivers behind eHealth. In addition to these master's courses, there are a number of MRes opportunities in Digital Health, for example at the Glasgow School of Arts. Furthermore, some postgraduate Nursing and Primary Care courses have modules in eHealth, Digital Health and Care, and in Digital Nursing. Given the fast pace of technological change and the digitisation of health systems, more digital health related courses for different aspects of the field are urgently needed.

The review also showed that while Health and Social Care courses are on offer in almost all colleges across the country, very few of them offer Digital Health education or training as part of their programmes or even as separate courses. This represents a great opportunity to include Digital Health modules into existing course curricula.

The DataLab - Innovation centre focussing on Big Data - supports master's courses in Data Science, which also produce staff for health informatics and data analytics. DataLab currently have in the region of 190 master's students across Scotland, and they serve several industries. As mentioned before, demand for staff with data analytic skills in the Health and Care sector is expanding.

6.3 Upskilling and reskilling

Consultation replies: Digital Health training needed by senior staff

Our consultees called for clear leadership from the Government, and engagement with the public, to make the aforementioned developments in education and training to happen. It was suggested that people in leadership positions should be trained as Chief Information Officers (CIOs) within health boards and the Scottish Government should push forward their digital agenda.

> *"It can't just be focused on junior learning or teaching young people how to use computers better, it has to be at the senior level as well. I think we need to think beyond just teaching doctors, because there are so many other staff members in the NHS who need to be trained i.e. Allied health professionals, senior nurses etc. We can't forget about the back-office staff, for instance finance and HR. So, we need to embed training into all professions… that shouldn't just be about digital computing or data it should be about increasing the capacity of people generally." (Research Institute focussing on Data)*

Ekosgen's research and analysis report into Scotland's Digital Technology sector noted that upskilling or re-skilling of the existing workforce is a significant challenge [32]. Continuing professional development (CPD) of the more senior members of the Digital Technologies workforce is seen as crucial for keeping up with the demands proposed by the changing technologies. This is perhaps almost as important as securing an adequate supply of new applicants to the sector [8]. In terms of the health sector, one of the consultees suggested that to the generation tasked to "implement changes in the use of digital technologies is perhaps the least likely to do so". This highlights the need for continued professional development of all staff in technical roles. Giving staff who are wary of digitisation an opportunity to engage with a digital buddy to help build their knowledge of and confidence in digital health.

NHS England has established a Digital Health Academy in London in 2017. The aim of the Academy is to upskill NHS staff in digital skills and innovation through masterclasses in leadership and change management. The Academy is led by Imperial College London in partnership with Harvard Medical School and the University of Edinburgh. This is the first programme of its kind to offer a national structured development programme in change management/leadership and clinical informatics for the NHS staff in England. A similar academy, or access to the classes provided by the Academy would be a valuable way for upskilling and reskilling senior staff in both NHS Scotland and in the overall Digital Health sector [59].

Consultation replies: In-house training and CPD

The consulted employers offer a range of both formal and informal CPD opportunities to their staff, this is seen as valuable for both the staff members and the company/organisation:

> *"The first three months that anyone spends in our company is focused on their training and the technical upskilling that they require. We do sometimes bring in external trainers but being part of an international company we have a wealth of information and resources to take advantage of. We tend to do a lot of self-learning and we have a lot of courses on our staff academy, which is a web application which any of us can access, and we get prescribed particular diets of courses that we have to do to brush up our knowledge of certain things and increase our skills. These courses are tailored to your job role." (Large Digital Health SME)*

> *"Yes, every staff member has a personal development plan. They have a review every 6 months but are encouraged to do upskilling every few months to keep their skills relevant. This is especially important for the developers who need to keep up with the changing software techniques that are coming onto the market. As mentioned previously, we also trained our clinical team to use our software which was a positive experience as well. The clinical team are all excellent. We have trained them in how to use the technology and to understand the software. They were very open to this and learnt very quickly. The majority of them have come from the NHS where they had been exposed to different types of tech anyway so it wasn't new to them." (Small SME focussing on Telehealth)*

6.4 Internships and apprenticeships

According to a survey by Digital Scotland, 82% of employers stated that their biggest challenge currently is trying to get the right technical people with the right skills or experience [8]. Almost 40% of employers currently have vacancies in technology roles, which means one to five posts on average per employer. The employers use a variety of solutions to meet the recruitment needs and challenges with a high focus on interns and graduates in particular (Figure 7). In addition, there has been a 46% increase in the number of Digital Technology Modern Apprenticeship places taken by young people. The apprenticeship family also includes Foundation Level Apprenticeships in Software Development, and Hardware and Systems Support, offered in schools. There are also Graduate Level Apprenticeships offered in the workplace in Software Development and IT management for business [8, 51].

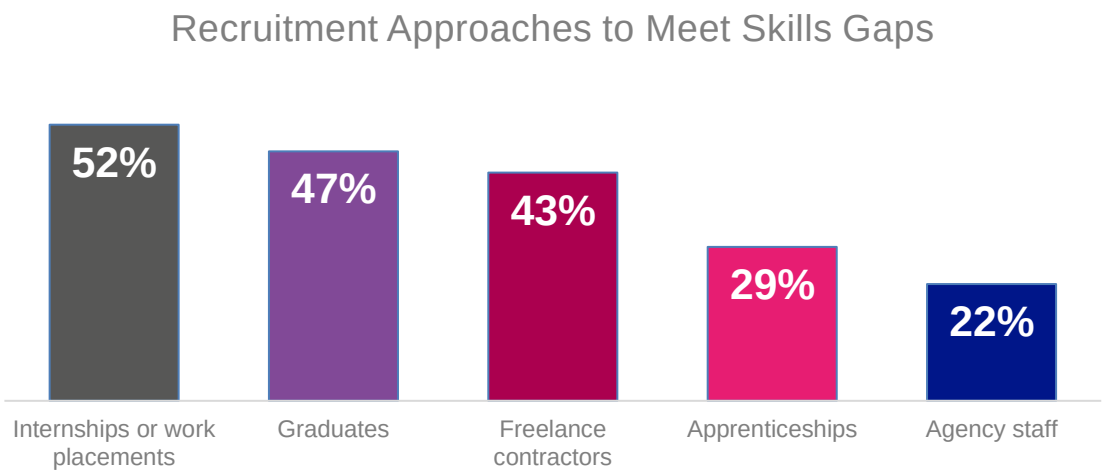

Figure 7: Recruitment approaches to meet skills gaps. Adapted from Digital Scotland 2016, p.35[8]

Consultation replies: Employers should be more involved in designing curricula

The employers' involvement in the education sector was variable, yet a desirable aim by all. Some companies had representatives on university courses' advisory boards, yet this yielded little actual influence in the planning of curricula. Many of the employers were working closely with local colleges, carrying out projects with them, and to develop industry-relevant qualifications.
One employer suggested Scotland should have something similar to the Digital Health Academy in London, which would give formal courses and a formal route into the healthcare IT sector. An increase in the numbers of industrial placements within Digital Health was also suggested as a way of boosting the numbers of people with the relevant skills and capabilities needed in the field.

> *"A forum should be set up whereby employers can influence undergraduate curriculum planning in order to plan in 5 year increments so that each degree group has the relevent training to work in the Digital Health industry and the changing health services when they graduate." (Special NHS Health Board)*

Consultation replies: Value of Graduate Apprenticeships

A smaller SME suggested increasing Graduate Apprenticeship opportunities would be valuable, as Digital Health companies look for real-world experience in graduates who have more of an entrepreneurial attitude.

> *"I was asked to comment on Graduate Apprenticeships, which I think would be a great thing because the students have industry experience making them much more mature, much wiser, more entrepreneurial and that is something I'm very supportive of. I think there needs to be much more engagement between industry and academia so that students actually get placements and real world experience whilst they're going through their degree. I think there's also value in teaching entrepreneurialism as a core skill and not just as an added module. For some courses, entrepreneurialism should be a core element of the degree. Design engineering is an example of this because they are designing and making products but have no exposure to industry and therefore have no idea how to actually sell a product and to think entrepreneurially". (Small Digital Health SME)*

> *"The Graduate and Foundation Apprenticeships have been fantastic for us because we have very enthusiastic people who are willing to learn and are essentially a blank canvas that we can move to understand the dynamics of our business." (Small Digital Health SME focussing on data sharing)*

> *"There needs to be more engagement between SMEs and the formal skills provision. Things like internships and industrial placements are excellent for getting young people used to working in a digital health start up". (Medium SME focussing on Remote Monitoring)*

Chapter 7 Conclusions and recommendations

7.1 Conclusions

Given the fast pace of technological change, the most important skill for a future digital health employee is not knowledge of any specific software but the ability to learn, re-learn and adapt to changing circumstances. Teaching principles of software development, applicable across the board, is probably more important than learning a specific programming language. Furthermore, embedding business or entrepreneurial training into computing and digital health courses, as well as offering more placements and internships as part of the degree courses would strengthen the skill sets of new graduates.

This report has examined skills and skills requirements within the emerging Digital Health sector. Digital Health is a subsection of the wider Technology sector, and consists of businesses and public-sector employers, who specialise in a field, or offer job roles, which combine IT know-how with healthcare expertise. In this report, we have focused on Digital Health companies that produce, provide and service digital health solutions, and on Health and Care providers that utilize and implement digital health solutions and tools in the delivery of their services. The emerging nature of the Digital Health sector is reflected in the mixed supply of staff into the sector from across the economy, and the types of job roles available within it. The categorisation made by TechCity divides digital technology job roles into *transformers*, *supporters* and *natives* [23]. The majority of the roles within Digital Health fall within the transformer and supporter categories, which indicate interdisciplinary skills requirements for staff. These include not only computer science skills and knowledge of health and care, but also various business, entrepreneurial and project management related skills both individually and in combination with each other.

The Digital Technology sector, which also encompasses Digital Health, is the fastest growing economic sector in the world. The Scottish Technology sector alone is expected to require 12,800 new employees each year until 2020. The job opportunities within Digital Health are expanding equally fast. Yet, there is high unemployment among Computer Science graduates, who are the main supply of workforce for the Digital Health sector: nearly 30% of university graduates are unable to secure full-time employment within 6 months of graduation in Scotland. At the same time, employers state that business growth in Scotland is severely restricted due to the lack of a higher skilled workforce. This is the problem: the skills supply does not meet the demands of the sector.

Computing is a diverse disciplinary domain, as is the job market graduates are entering in to. The fast-changing technology continuously creates new skills needs for the workforce. As the Shabolt review found, the challenge for the higher education sector is to be able to provide up-to-date, agile and

relevant content that meets the needs of the industry, while also securing a common core of essential knowledge in the computing courses [58]. Currently, the Higher Education curricula are not able to respond fast enough to these changes. This applies also to the training of the overall health and care workforce.

Furthermore, there are few opportunities to gain knowledge of both healthcare *and* computer science through study alone, and these are primarily available at a postgraduate level. This provision should be expanded to cater for the evolving Digital Health market. This includes providing training and support for staff in leadership positions in order for them to make informed decisions about digital health infrastructures, systems and devices, as well as on additional staff training needs.

The Digital Health sector is hungry for higher skilled computing science staff, especially in software development and software engineering. In the future, the demand will focus on staff with skills such as data analysis, data visualization and cyber security. This is due to the concentrated effort to use genomics, precision medicine, Big Data, data analytics, population health, Artificial Intelligence, cloud computing, mobile health, wearable technologies and robotics to advance the provision of Health and Care in Scotland.

The accelerating pace of technological development in Digital Health will have a directly proportionate effect on the increased skills requirements of the workforce. Providing the workforce with the tools to learn, re-learn and improve upon their existing skills will be a key enabler in future-proofing Scotland's workforce in the ever-changing Digital Health and Care sector.

7.2 Recommendations

In order for Scotland to capitalize on the expanding Digital Health market, it is vital to ensure a sufficient supply of skilled worker are being attracted into the sector. The education provision can be influenced positively based on these findings. The recommendations below suggest a number of opportunities for decision-makers take forward in order to prepare people to work in the Digital Health sector, and to better engage with the skills needs of the industry.

Based on our research, we have 19 recommendations falling into three categories:

1) Better alignment of and more collaboration between the Digital Health sector and the Education/Training sector

a) Engage Digital Health employers more closely in curriculum re-design to ensure the provision meets industry needs.
b) Increase the availability of industrial placements and work placements to allow students real-life experience and exposure to work practices, culture and values, to provide an understanding of the required skills in the sector. This is particularly important within an industry like Digital Health, which is still a relatively novel field.
c) Consider increasing the availability of "sandwich courses", which embed a work placement section in between periods of study. Industrial placements give students exposure to relevant real-life issues and equip them with appropriate work experience and skills to make them better suited to working life after graduation.

2) Raising the profile of the Digital Health sector in Scotland

a) Create defined career profiles and pathways for the Digital Health sector to attract and retain staff. The Digital Health sector needs to be branded in such a way to achieve this.
b) Raise awareness of and promote Digital Health as a career opportunity to school leavers, college and undergraduate students and those looking to change careers, or return to work.
c) Educate senior leadership and management of the importance of and possibilities offered by the Digital Health sector, upskilling them in digital transformation and change management. This will enable those in influential positions to push the relevant digital health agendas forward, thus impacting upon the education provision, as well as on the upskilling of current staff. This is crucial for the necessary culture change to take place. Assigning digital buddies to senior leaders would be one way of addressing this issue.
d) Ensure sufficient levels of digital literacy among the citizens to secure the uptake of digital health systems and devices, and to capitalize on the efficiencies and savings that these promise.

3) Review of the existing education and training provision for Digital Health

a) Higher Education and Further Education institutes should consider reviewing their existing course portfolios and introducing new stand-alone specialist Digital Health courses, as well as embedding digital health content into existing Health and Care, and Computer Science courses. Digital Health courses could also be offered at undergraduate level and as CPD options for the existing workforce.

b) Cross-breed and embed computer science and health and care expertise into all levels of tertiary education. Medical, and health and care students should be exposed to available digital health technologies throughout their academic career. Whilst at the same time computer science students should be exposed to the nature of work and needs of the Healthcare sector. Creating awareness of the art-of-the-possible in Digital Health and of issues relevant to their course of study may help create a workforce motivated to evolve, change and create a "pull" for Digital Health and Care services.

c) Consider increasing student intake on relevant courses such as software development, software engineering, and cyber security. This is crucial for ensuring a sufficiently skilled workforce to work in the Digital Health sector in Scotland.

d) All entrants into the Digital Health sector should have transferrable skills, and the ability to learn and re-learn new skills on the job and be aware of generic principles of Software Development. Given the fast pace of technology change, the graduates need a flexible toolkit of knowledge that can be adapted to the fluid Digital Health industry.

e) Embed business and entrepreneurship in training as part of computer science and digital health courses both at university and college level.

f) Data Science needs to be seen as a key component of the Digital Health sector. All courses feeding into the Digital Health sector must have data science elements. This includes Medical degrees, where students must gain an appreciation for data and its inherent benefits to providing better and more personalised care. The number of data science courses should be increased and offered as a variety of modules by way of CPD for staff. Scottish universities need to ensure that Data Science graduates are able to support the Digital Health industry to get value from the data in the sector.

g) Consider making data science modules compulsory to all relevant Higher Education courses much like ethics modules currently are.

h) A more widespread provision of statistical training into programmes such as R and Python need to be incorporated into the degrees feeding the Digital Health sector. Knowledge of these programmes will be very useful as more data is aggregated in businesses and put to use.

i) Educate students about innovation to create a workforce of the future that is receptive to improvements and able to actively participate in transformational change.

j) Upskill existing staff in SMEs and Health and Care organisations. This should be symbiotic with the upskilling of entrants to the company and ensure that all staff have the technical skills and ability to work effectively in the ever-changing Digital Health industry. The NHS and Care providers should upskill existing staff to drive forward and cope with the transformational change that digitisation is bringing to Health and Care and help the staff to take advantage of the influx of available data that digitisation is bringing to the sector.

k) Promote and increase the uptake of work-based learning opportunities in the sector such as relevant Foundation Apprenticeships, Modern Apprenticeships and Graduate Apprenticeships.

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Appendix 1

Consultation Schedule

Description of your field and Drivers for change (Demand):

1. Description of the business/industry: could you please explain what it is that your business/organisation does?
    a. What section of the Digital Health sector do you specialise in?

2. How is it going for your business/organisation at the moment?

3. What are the most important things affecting growth of your sector?
    a. How are technological developments and the pace of technological change affecting demand for services in your sector?
    b. To what extent are developments in the wider health and care sector affecting demand for services in your sector?
    c. Are there any policy changes affecting the demand for services in the sector? E.g. integration of health and care services, eHealth strategies, Scotland's Digital Future, Digital Scotland, etc.

Availability of skilled workforce (supply)

4. What types of job roles do you have in your sector?

5. What are the most common types of skills required in the jobs in your sector (the most essential core skills)?

6. Is your company currently recruiting, or have you recently been recruiting new staff?

7. What is your experience of the available supply of skilled workforce like?
    a. Does your sector experience any challenges in recruiting staff with right skill sets and qualifications?
    b. If so, in which occupations and which skill sets (which geographical area) are these issues most acute with?
    c. Is there any difference between sub-sectors, and why?

8. Where/in which sub-sectors are there the greatest number of hard-to-fill vacancies?
    a. What are the reasons for this?

9. Are there any other constraints to recruitment besides skills issues?

a. What is the gender balance like in your sector? *How does this affect meeting growth /expansion demand? Is this a recognised issue in the sector?*

Addressing skills demand

10. Are there sufficient numbers of people entering the sector?
- **a.** What routes into the sector are there?
- **b.** How could this be improved?

11. You mentioned XXXX changes in your sector. Have these affected the types of skills needed?

12. You have mentioned xxx skills are in short supply. How could this problem be addressed? Who should address it?

13. What is your current level of engagement with the skills system? E.g. are you involved in curriculum planning with colleges or universities, or do you take on Modern Apprenticeships?

14. Does your company offer CPD or any type of skills development/training opportunities to your employees?

15. How could workforce development be improved in your company?

16. Are there any other considerations regarding skills provision in the Digital Health sector generally?

17. If you imagine we are 5-10 years ahead of time in the future, how do you see the sector developing in that time? What types of skills needs do you envisage your sector has then?

18. Are there any further comments you would like to add?

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