

Where Digital Health Thrives: Future Skills Needs

Industry Skills
Needs Analysis
2023-2026

**Prepared by HealthXL
in collaboration with
Connected Health
Skillnet and Ibec's Irish
Medtech Association with
Biopharmachem Ireland.**



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Contents

Foreword	2
Foucs of this report	6
What this research found: Executive Summary	7
Section 1 - Global overview of digital health	10
1.1 Defining digital health	11
1.2 Evolution of the global business environment	16
1.3 The business model and the strategic imperative for collaboration	17
Section 2 – International insights on digital health industry roles and skills needs across sectors	20
2.1 International insights from desk research on digital health industry workforce	21
Section 3 - A skills framework for the digital health sector	30
3.1 A skills framework to guide the skills benchmarking analysis	31
3.2 Digital health archetypes	35
Section 4 - Benchmarking international digital health industry workforces	38
4.1 Skills Analysis of the Digital Health Workforce	39
Section 5 - Expert insights into future digital health skills needs	46
5.1 Current and future skills gaps: The international perspective	47
Section 6 - High level skills priorities for digital health in Ireland	52
6.1 Digital health: A growing priority for Ireland's life sciences and technology industry	53
6.2 Skills priorities for the digital health sector in Ireland	56
6.3 Preferred methods for upskilling a digital health workforce	59
6.4 Expert Insights on Upskilling Digital Health Workforces	61
Section 7 - Recommendations to develop a world leading digital health workforce in Ireland	64
Section 8 - Ireland, a location of choice for digital health	68
8.1 Ireland, a location of choice	69
8.2 The Digital health ecosystem in Ireland	70
Section 9 - Conclusion	74
9.1 Ireland: A potential digital health R&D powerhouse	75
References	76
Appendices	77

Foreword

This important research identifies the skills and competencies required for the design, development and commercialisation of digital health products and services.

The digitalisation of healthcare has the potential to fundamentally alter how we diagnose, treat and care for people. The boundaries of this new and exciting field have yet to be fully defined and are likely to expand over time as advances in digital technology and life sciences bring new therapies and applications into being. As we look to the future, we need to do more to ensure the sustainability of our health system and better access to care. At a global level, the OECD warned in 'Tackling Wasteful Spending on Health' (2017) that one fifth of healthcare expenditure, \$1.3 trillion annually, is wasted with unnecessary practices and inefficiencies. Nevertheless, health spending continues to increase with preliminary estimates from the OECD, released late in 2022, indicating that there was an average 6% increase in health spending in 2021, following faster growth in 2020 during the global Covid-19 pandemic.

Digital health can help address these concerns as it is underscored by the goals of lowering the cost of healthcare, and increasing access to healthcare, while empowering patient outcomes, and improving health systems. Indeed, the OECD is advocating for creating a more resilient, person-centred health system, that is powered by analytics. Although technology is rapidly evolving, the group has advised that the barriers to a 21st century health system are not technological. The key to success identified is tackling institutional, processes, and workflow, obstacles.

According to Grand View Research, the global digital health market was estimated to be worth \$175.6 billion as of 2021 and is projected to grow at a compound annual rate of 27.7% from 2022 to 2030 making it worth potentially more than \$1.5 trillion by that date¹.

Ireland's worldclass health technology ecosystem already boasts 700+ businesses which employ 90,000 directly across both the world's top medtech, biopharma, and digital health companies, as well as disruptive startups addressing unmet clinical needs with the latest cutting-edge technology.

Ireland has the potential to establish itself as a global hub and centre of excellence for the burgeoning digital health sector and is starting from a strong foundation in that regard with many of the world's leading life sciences and ICT firms already based in this country. But that potential may go unrealised if we fail to develop the skills required by this exciting new industry sector.

Moreover, business leaders have identified a number of key arguments for Ireland being an attractive location to start and grow a business, namely, its strong leadership, its existing track record supported by world class talent, culture of collaboration in its well-established ecosystem, and supportive business environment.

Ibec is uniquely equipped to support this as the leading business representation organisation in Ireland with 40 trade associations, and as the promoting partner of key Skillnet Ireland networks such as the Connected Health Skillnet. Indeed, it is thanks to this incomparable access to cross-sectoral industry foresight and best practice sharing that the group has been able to develop the 'Where Digital Health Thrives' campaign to enable Ireland to become a recognised global hub for digital health. This campaign brings together Ibec's Irish Medtech Association, Technology Ireland and BioPharmaChem Ireland, with the Connected Health Skillnet to specifically support talent development across this niche segment.



Dr Sinead Keogh

**Head of Sectors, and Director
of Medtech and Engineering, Ibec**

This initiative identified five strategic priorities, with “Support the development of a worldclass talent pool for the digital health sector” being listed as a key enabler for success. That is why Connected Health Skillnet and Irish Medtech Association, supported by Skillnet Ireland, commissioned this important research to identify the skills and competencies required for the design, development and commercialisation of digital health products and services.

This research will help Connected Health Skillnet achieve the Skillnet Ireland mission to enable businesses in Ireland to be the best it can be, through innovative and enterprise-driven people development.

Ireland has the potential to establish itself as a global hub and centre of excellence for the burgeoning digital health sector which is projected to be worth in excess of \$1.5 trillion by 2030.

700+

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Dave Flynn

Director of Business Networks, Skillnet Ireland

We live at a time of technological change that is unprecedented in its pace, scope and depth of impact. Harnessing the progress made possible by increased digitalisation is the surest path for organisations to deliver on their future innovation and talent agenda.

Ireland is recognised internationally as a centre of excellence for life sciences due to the availability of its highly skilled, adaptable, and mobile workforce. However, skills are dynamic and can become dated meaning a persistent focus must be maintained on the development of our workforce. There is a need to ensure the skills base reflects not just the current business demands but the challenges of future growth in in the development and commercialisation of future digital health solutions.

This report commissioned by Connected Health Skillnet and Irish Medtech Association, offers in depth research into the future skills needs of the digital health industry, offering insights from medtech, pharma and digital health professionals in Ireland and further afield. The findings and recommendations from this research highlight exciting possibilities to develop impactful learning interventions that ensure the best alignment of people and technology with the right opportunities within organisations, The report also outlines enterprise-led plans to develop the new skills required for new digital health roles across the entire value chain from research and development to product approval.

We would like to acknowledge all those who contributed to this research report. We would also like to thank all the member companies of Connected Health Skillnet who participated in the research. We encourage all stakeholders to consider the many ways organisations can support the development of a worldclass talent pool for the digital health sector in Ireland, further building Ireland's reputation as a global digital health centre of excellence.

Ireland is recognised internationally as a centre of excellence for life sciences due to the availability of its highly skilled, adaptable, and mobile workforce.



Jennifer McCormack

Network Manager, Connected Health Skillnet

As both the medtech and biopharma sectors increasingly invest in digital health technologies, there will be a parallel rise in the need for skills enabling the development and implementation of digital health solutions. This research shows that demand for digital health skills outstrips supply at present. New skills are required across the entire value chain from research and development to product approval, commercialisation, and eventual end-user adoption. Key roles include software developers, product designers, and user experience researchers with healthcare industry experience or knowledge. More traditional healthtech industry roles such as regulatory compliance, distribution, and reimbursement will also require upskilling for digital health.

This research and the resulting skills framework are already shaping the Networks strategic focus and will inform the development of new upskilling and reskilling initiatives for the sector over the coming years. We look forward to working more closely with companies in this dynamic space to help equip the workforce with the skillsets required to propel Ireland to the forefront of digital health globally.

We would like to thank the Connected Health Skillnet Steering Committee and Ibec Digital Health Working Group for their guidance and dedication throughout this project

New skills are required across the entire value chain from research and development to product approval, commercialisation, and eventual end-user adoption.

Focus of this Report

Digital health has the potential to fundamentally alter how we diagnose, treat and care for people. Over the past few years, the life sciences industry has increasingly started exploring this nascent, albeit thriving space, with many partnerships defining the early ventures of medtech and biopharma in digital health. As medtech, biopharma and the ever-growing startup ecosystems are considering digital health opportunities in earnest, many companies have begun diversifying their workforce - creating new digital health roles, upskilling their existing workforce and hiring new talent to deliver on new and bold digital health strategies.

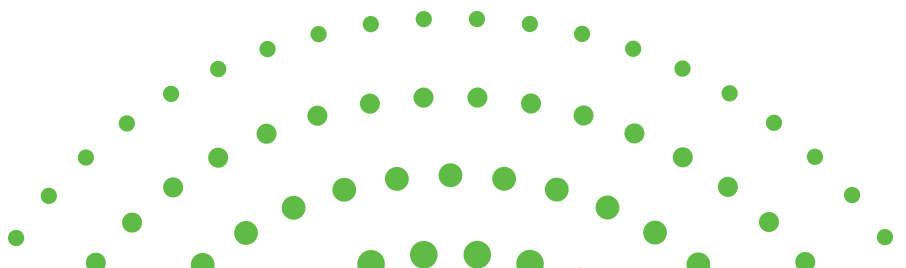
In conducting this research, Connected Health Skillnet and Irish Medtech Association together with Biopharmachem Ireland wanted to help enhance Ireland's potential as a global hub for digital health where companies can design, develop and commercialise digital health solutions, by ensuring that we understand and are building the right skills mix (both current and future) to capitalise on the opportunity.

The aim of this report therefore, is to equip the Connected Health Skillnet and companies within the associated sectors in Ireland (and beyond) with informed insights into digital health skills capability building in order to boost competitiveness through talent.

With that in mind the objectives of this report are threefold:

- To provide a benchmark of digital health roles and associated skill sets currently in existence in the medtech, pharma and startup sectors to better understand the profile and diversity of the skills and job roles required for a world class digital health talent pool.
- To provide expert-led insights on current and future skill demands for the industry in Ireland.
- To inform the development and delivery of industry driven and grant funded training programmes which are fit for purpose for the Irish digital health workforce through the Connected Health Skillnet, and other educational institutions.

As medtech, biopharma and the ever-growing startup ecosystems are considering digital health opportunities in earnest, many companies have begun diversifying their workforce - creating new digital health roles, upskilling their existing workforce and hiring new talent to deliver on new and bold digital health strategies.



What this research found:

Executive summary

The digital transformation of the health sector has become indispensable, the EU noted in response to the 'Regional digital health action plan for the WHO European Region 2023–2030'. The plan intends to support countries in leveraging and scaling up digital transformation for better health and in aligning digital technology investment decisions with their health system needs, while fully respecting the values of equity, solidarity and human rights.

The WHO's strategic vision is to "improve health outcomes for everyone, everywhere, by (i) accelerating the development and adoption of appropriate, accessible, affordable, scalable and sustainable person-centric digital health solutions to prevent, detect and respond to epidemics and pandemics, and (ii) developing infrastructure and applications that enable countries to use health data to promote health and well-being²⁹".

Why digital health is essential for a modern health system:

- **Empowering patients:** Digital health is driving the personalisation of medicine and healthcare, putting the patient at the centre of their treatment in an informed and supported manner. Through connected devices, remote monitoring, apps and other technologies patients are empowered to manage their health and receive care in the right setting.
- **Supporting healthcare professionals:** Digital health is supporting health care professionals by offering insights with data. From the data you get insights, actions, real-world-evidence and feedback. With data from connected devices, Health Care Professionals (HPCs) can measure outcomes, personalise healthcare, and better connect with patients in multiple care settings.
- **Improving health systems:** Digital health is supporting the global shift to value-based care and payment for outcomes. Digital health is underscored by the goals of improving outcomes and patient support, increasing access to healthcare along with lowering the cost of healthcare. This not only leads to improved outcomes for patients and HCPs, but for payers and providers too.

With the global digital health market has been estimated to be worth \$175.6 billion as of 2021¹, the life sciences industry is keen to capitalise on this sizable market. With digital health in its infancy, the demand for skills to support this sector far outstrips the supply. This is further compounded by the fact that staffing demands apply to the entire spectrum of the digital health value chain - beyond research and development to sustainable commercialisation. While software developers, product designers and user experience researchers are key roles for digital health, they will benefit from health-specific domain knowledge. Equally, specific roles supporting the regulatory compliance, distribution, reimbursement and ultimately adoption of digital health products, are required in order to build the digital health edifice. Furthermore, leadership roles will be essential in articulating a sustainable vision and successful strategy for digital health.

Many of the key digital health roles and functions needed across medtech, biopharma and digital health companies are still being defined, and as such organisations entering this space are figuring out how new functional requirements translate into demands for key skills and competencies for a digital health workforce.

With the world's top medtech, pharmaceutical and technology companies investing heavily and creating jobs in Ireland, alongside a thriving ecosystem of homegrown businesses driving disruptive innovation, the ecosystem here is already taking steps to ensure Ireland is a place where digital health thrives. As mentioned above, Investment figures point to digital health as a booming sector of the healthcare industry with high growth potential. To capitalise on this opportunity, the Irish digital health sector needs to grow and deploy a specialised skilled workforce.

With the global digital health market estimated to be worth \$175.6 billion as of 2021, the life sciences industry is keen to capitalise on this sizable market.

The main takeaways from this research are:

1. The Irish digital health sector is uniquely focused on digital R&D as a key priority for upskilling. It is anticipated that the skills in greatest demand over the next four years will be:
 - Product design and user experience
 - Software Development, programming and coding
 - Data science and artificial intelligence
2. Digital health roles in medtech and biopharma are a relatively new development.
3. The majority of digital health roles in both the medtech and biopharmaceutical industry presently sit within the category of 'digital and broad innovation'. Many of these roles are focused on strategy and partnership building.
4. In Ireland, the proportion of digital health roles in medtech and biopharma is low at present, when compared to the US or the UK. However, Ireland is an important testbed for innovation, with digital health primarily driven by small to medium sized digital health/technology companies.
5. The analysis of the skills composition across the global sample digital health workforce (drawn from companies in the US, UK and Ireland), reveals that, at present, a higher percentage of the workforce is focused on implementation (commercialisation and enablement and support), rather than production (domain knowledge and digital health R&D).
6. Interestingly, within this digital health workforce sample, Ireland leads the pack with a higher concentration of essential skills in software development, advanced data analytics and information management/ cybersecurity.
7. Experts consulted in this research have suggested that Irish-based digital health companies stand to benefit from developing capabilities in product commercialisation in order to maximise value extraction from their world class R&D efforts.
8. Health technology companies in Ireland clearly see the potential for growth through digital health, with many companies - large and small - planning to increase their digital health activity over the next four years.
9. Of the 46 Ireland-based companies that participated in a survey as part of this research, the vast majority (87%) confirmed that their Irish-based operations will play an important role in achieving corporate digital health ambitions.
10. The most common qualification amongst the digital health workforce sample across all three regions is a masters degree, with nearly half (42%) and of the Irish digital health workforce holding a postgraduate qualification. The top two subject areas of these qualifications across the three regions were life sciences and management degrees.
11. Investing in the development of one single skills area will not put Ireland on the map as a hub for digital health talent and innovation. Rather companies need to build teams consisting of employees with complementary skills who, importantly, can all speak the same digital health language.
12. Rather than building lengthy degrees specific to digital health, experts consulted in this research suggested that digital health modules should be weaved into the core curriculum for relevant STEM university programmes. The emerging STEM workforce would subsequently be equipped with the awareness and knowledge of the types of careers available within digital health.

In the Irish digital health sector the skills in greatest demand over the next four years will be Product design & user experience; software development, programming & coding; and, data science & artificial intelligence.

Research methodology

Objective of the skills needs report

The Connected Health Skillnet and Ibec's Irish Medtech Association tendered for the provision of consultancy services to deliver a skills analysis report for the digital health sector. HealthXL was selected to undertake the skills needs analysis.

Definition

The health technology and life sciences sector is comprised of the biopharmaceutical, medical technology, biotechnology, digital health and other allied stakeholders across the ecosystem.

Steering Committee

HealthXL worked closely with the Connected Health Skillnet, Ibec's Irish Medtech Association and the Skillnet's industry steering committee on this project.

Approach

HealthXL gathered quantitative as well as qualitative data in completing the skills needs analysis. Quantitative and qualitative data was gathered at different junctures of the project:

Phase 1 (Benchmarking):

Quantitative data on company workforces was gathered across a selection of top-tier medtech and biopharmaceutical companies as well as notable digital health companies/startups and incubators/accelerators to understand the composition and focus of the Irish digital health workforce. A similar exercise was undertaken to better understand the composition of the UK and US digital health workforces. The resulting dataset consisted of 968 digital health roles that were identified as part of this research. Information on the companies included in the digital health workforce sample are included in the appendix.

Phase 2 (Skills needs and skills framework):

Qualitative data was collected throughout to understand industry trends, skills needs and upskilling preferences. Three roundtables were convened with twenty-two senior experts representing the medtech, biopharma and digital health sectors in Ireland, the UK and the US.

A further twenty-two one-to-one expert interviews were conducted to build out a framework underpinning the skills benchmarking and needs analysis. As the core focus of this project was on Ireland, experts were primarily sourced from within Ireland but also internationally.

Phase 3 (Skills demand in the Irish sector):

Two industry surveys were conducted focused on understanding digital health skills demands in Ireland and abroad over the next four years. Survey one sought to understand the international perspective and was distributed to HealthXL's global community and Ibec's international network. Fifty-nine senior industry executives completed survey one. Survey two, completed by fifty-two industry executives, sought to understand the Irish perspective in greater detail and was distributed to Ibec's membership. Insights from both surveys are central to this report and will guide future digital health skills development initiatives for the sector through Connected Health Skillnet.

Expert Contributions

Through roundtables, interviews, surveys and the industry steering committee a total of 170 individuals contributed to the digital health skills needs analysis for Ireland. Experts were senior industry executives, thought leaders and digital health startup entrepreneurs.

The Digital Health Skills Framework

A digital health skills framework was developed as part of this skills analysis. The original structure of the skills framework was derived from the analysis of digital health profiles included in the quantitative dataset (phase 1). The framework underwent numerous iterations and was continuously refined and validated following expert input during stakeholder roundtables and one-to-one interviews. The skills need analysis presented in this report is anchored on the four pillars of this framework. Given the international exposure and expertise of many of the experts consulted, the framework holds up beyond the Irish context.

Section 1

Global overview of digital health



This section provides an introduction to digital health and describes the intersection of digital health with the medtech and biopharma industries.

1.1 Defining digital health

For the purpose of this report, “digital health” refers to software and data driven connected health technologies with application across medtech and biopharma value chains as well as patient and consumer journeys.

Digital health, an emerging paradigm situated at the intersection of ‘health’ and ‘technology’, has increasingly been drawing the attention of the medtech and pharmaceutical industries. In recent years many definitions have emerged, seeking to clarify the meaning and outline the boundaries of digital health. A leading definition, coined by HealthXL, the Digital Therapeutics Alliance (DTA), Digital Medicine Society (DiME) and Node. Health is outlined in Box 1.1.

Digital health includes technologies, platforms, and systems that engage consumers for lifestyle, wellness, and health-related purposes; capture, store or transmit health data and/or support life science and clinical operations. It is a broad category encompassing both digital medicine and digital therapeutics.

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Box 1.1: Defining digital health

Digital Health			
		Digital Medicine	
		Digital Therapeutics	
Definition	Digital health includes technologies, platforms, and systems that engage consumers for lifestyle, wellness, and health-related purposes; capture, store or transmit health data; and/or support life science and clinical operations.	Digital medicine includes evidence-based software and/or hardware products that measure and/or intervene in the service of human health. ¹	Digital therapeutic (DTx) products deliver evidence-based therapeutic interventions to prevent, manage, or treat a medical disorder or disease. ²
Clinical Evidence	Typically do not require clinical evidence.	Clinical evidence is required for all digital medicine products.	Clinical evidence and real world outcomes are required for all DTx products.
Regulatory Oversight	These products do not meet the regulatory definition of a medical device ³ and do not require regulatory oversight.	Requirements for regulatory oversight vary. Digital medicine products that are classified as medical devices require clearance or approval. Digital medicine products used as a tool to develop other drugs, devices, or medical products require regulatory acceptance by the appropriate review division.	DTx products must be reviewed and cleared or certified by regulatory bodies as required to support product claims of risk, efficacy, and intended use.
Product Examples	<p>Data & information capture, storage, and display</p> <ul style="list-style-type: none"> • User-facing technologies <ul style="list-style-type: none"> – Lifestyle apps – Fitness trackers – Nutrition apps – Medication reminder apps – Scheduling apps • Health Information Technology (HIT)⁴ <ul style="list-style-type: none"> – Electronic medical record systems – Electronic prescribing⁵ and order entry systems • Consumer health information <ul style="list-style-type: none"> – Online repositories – Personal health records – Patient portals 	<p>Measurement products</p> <ul style="list-style-type: none"> • Digital diagnostics <ul style="list-style-type: none"> – Software-driven connected technologies that detect or confirm the presence of a disease or condition of interest or to identify individuals with a subtype of the disease • Digital biomarkers <ul style="list-style-type: none"> – Digital tools that measure patient characteristics that are objectively measured and evaluated as an indicator of normal biologic processes, pathologic processes, or biological responses to a therapeutic intervention – Includes all BEST biomarkers • Electronic clinical outcome assessments <ul style="list-style-type: none"> – Digital measures of how patients feel, function, or survive 	<p>Software that delivers a therapeutic intervention</p> <p>Medical claims include:</p> <ul style="list-style-type: none"> • Treat a disease <ul style="list-style-type: none"> – Digital therapeutics that deliver a medical intervention to treat a disease. • Manage a disease <ul style="list-style-type: none"> – Digital therapeutics that deliver a medical intervention to manage a disease. • Improve a health function <ul style="list-style-type: none"> – Digital therapeutics that deliver a medical intervention to improve a health function and/or prevent a disease.



The realm and scope of digital health is extremely broad (see Box 1.2) and goes beyond data and information capture, storage, display, transmission and evaluation of this data to include measurement and intervention products. Box 1.2 outlines prominent examples of solutions and products commonly described as digital health. Digital health intervention products may also be solely software based such as digital therapeutics (DTx) and would not include a hardware component (though the intervention would likely be delivered via a mobile application on a hardware device such as a smartphone).

Box 1.2: Example of digital health products including digital medicine and digital therapeutics

Digital Health			
		Digital Medicine	
Product Examples (continued)	<p>Data & information transmission</p> <ul style="list-style-type: none"> • Telehealth <ul style="list-style-type: none"> – Telemedicine virtual visits – Remote care programs that do not include remote monitoring • Decision support software that:⁶ <ul style="list-style-type: none"> – Presents information for independent clinician review – Does not make recommendations that the user could not find through channels other than the software • Enterprise support <ul style="list-style-type: none"> – Clinical trial operations & management tools – Trial management software – Trial recruitment platforms • Clinical care administration & management tools <ul style="list-style-type: none"> – Revenue cycle management tools – Clinical staffing management tools – Length of stay monitoring and management tools 	<p>Measurement products (continued)</p> <ul style="list-style-type: none"> • Remote patient monitoring <ul style="list-style-type: none"> – Remote monitoring tools – Medication adherence tools – Sensor technologies that measure vitals and physiologic data • Decision support software that:⁷ <ul style="list-style-type: none"> – Relies on data inputs from medical imaging or in vitro diagnostic devices – Process or analyze this information without clinician input <p>Measurement & intervention products</p> <ul style="list-style-type: none"> • Digital companion⁸ <ul style="list-style-type: none"> – Digital component integrated with either a drug or biologic – Ingestible sensors – Connected drug delivery device – Insulin pump • Digital products that both 1) measure and intervene, and 2) do not require human intervention to serve primary purpose <ul style="list-style-type: none"> – Artificial pancreas – Pacemaker – Cochlear implant – CPAP 	<p><i>Core principles all digital therapeutics</i></p> <ul style="list-style-type: none"> – must adhere to:⁹ – Prevent, manage, or treat a disease – Deliver a software-driven medical intervention – Employ design, manufacture, and quality best practices – Ensure end user engagement – Implement privacy and security protections – Apply product deployment and maintenance best practices – Conduct clinical trials and publish results – Undergo applicable regulatory reviews – Make appropriate claims – Utilize real world outcomes

1 <https://www.dimesociety.org/index.php/defining-digital-medicine>

2 <https://www.dtxalliance.org/dtxproducts/>

3 It is important to check with local regulatory requirements in each jurisdiction the product is manufactured, registered, or used in.

4 In the United States, ONC-certified EHR functions are not devices according to the FD&C Act, as amended by 21st Century Cures Act.

5 In the United States, while these do not require FDA oversight, there may be rules within specific states that govern these technologies.

6 <https://www.fda.gov/media/109618/download>

7 Ibid.

8 Note: 1) integration of the digital tool with an existing drug or biologic requires a label change for the drug or biologic, and 2) regulatory requirements may recognize digital tools coupled with a drug or biologic as a combination product.

9 <https://www.dtxalliance.org/aboutdtx/>

Thus, when considering key skills and competencies required for digital health to thrive in Ireland (and elsewhere), we refer to skill sets needed to **design, develop, test, regulate, implement and commercialise a diverse range of solutions and products** ranging from digital diagnostics and remote monitoring solutions to connected drug delivery

devices and connected medical devices such as connected pacemakers and glucose monitors. Digital health solutions are inclusive of hardware and/or software.

The differences in how digital health is ‘operationalised’ across medtech and pharma are illustrated in Boxes 1.3 and 1.4.

Box 1.3: Digital health in medtech

The medtech sector is specialised in the development and production of medical devices and technologies designed to improve or save people’s lives. Digital has been the way forward for medtech for a while now - for example with products such as connected pacemakers and other connected devices that allow for the remote monitoring of a patient. Similarly, even the most traditional medtech products such as smart bandages and plasters are being augmented and are now capable of sensing wound moisture levels and transmitting this information to a smartphone.

Digital health within medtech refers to connected hardware products (for the purpose of diagnosis, treatment or monitoring) that interface with and communicate data with a platform or application, as well as software- and data-driven services and solutions (including decision support) that have a use-case along the various junctures of patient and provider journeys from screening and diagnosis, to treatment and post-treatment or intervention surveillance.

Digital health

Medtronic acquires behaviour change platform Klue.

Klue is a software company focused on behaviour tracking. Klue uses AI gesture sensing technology to monitor food consumption in real-time. Klue feeds information on consumption behaviour back to the patient in an effort to initiate and maintain behaviour change.

Not digital health

Aesculap received FDA 510K clearance for its DIR800 3D digital infrared fluorescence

The DIR800 is an accessory for the Aesculap Aeos Robotic Digital Microscope that digitally augments on-screen images with multiple imaging modes. It is an augmented and optimised version of a traditional optical instrument.

Example Sources: <https://www.mobihealthnews.com/news/north-america/medtronic-scoops-gesture-tracking-startup-klue-bolster-personalized-closed-loop>; <https://www.aesculapusa.com/en/company/news/Aesculap-Inc-Receive-510k-Clearance-for-Aesculap-Aeos-Robotic-Digital-Microscope-DIR800-Capability.html>

When considering key skills and competencies required for digital health to thrive in Ireland, we refer to skill sets needed to design, develop, test, regulate, implement and commercialise a diverse range of solutions and products ranging from digital diagnostics and remote monitoring solutions to connected drug delivery devices and connected medical devices

Box 1.4: Digital health in pharma

The pharmaceutical sector has traditionally focused on the development and production of drugs and medications. Digital health, however, is poised to fundamentally alter drug discovery, product and service offerings across the sectors and consequently shake up entrenched business models.

Pharma has been slow to explore digital health. Nonetheless, technological advancements are slowly changing how companies discover and develop new drugs, how they deliver their drugs, and gather data on the efficacy of their products in real life settings.

Pharma is also increasingly digitising its assistance programmes and other support for its patients. More recently, the sector has begun exploring the potential of DTx (software driven interventions designed to prevent, manage or treat a medical condition) as either standalone products or in combination with medication (HealthXL et al, 2019; DTA). Similarly to the digital health opportunity in medtech, the opportunities for pharmaceutical companies in this nascent space span the entire pharma value chain and have the potential to enhance patient and caregiver journeys.

Digital health

In 2019 Happify Health and Sanofi announced a collaboration to develop a prescription digital therapeutic to manage and improve the mental health of people with multiple sclerosis.

Digital Therapeutics can be used independently or in tandem with medications, devices, or other therapies to address unmet needs or improve health outcomes. Many pharma companies strategically invest in such technologies.

Not digital health

In 2019 Roche acquired molecular information company Foundation Medicine. Through the merger Roche intends to realise its vision of personalised healthcare.

Foundation Medicine offers comprehensive genomic profiling to identify the molecular alterations in cancer, using this information to match patients with the right treatments and clinical trials.

Example Sources: <https://www.sanofi.com/en/media-room/articles/2019/happify-collaboration>; <https://www.happifyhealth.com/>; <https://www.businesswire.com/news/home/20201123005663/en/Schr%C3%B6dinger-Announces-a-Multi-Target-Drug-Discovery-Development-and-Commercialization-Collaboration-with-Bristol-Myers-Squibb>; <https://www.foundationmedicine.com/press-releases/24c62ccb-a2c4-47cf-b2d5-c7e6378c08fe>



1.2 Evolution of the global business environment

Progress in research and innovation, along with advances in technology are now making transformative digital health products and services possible leading to major growth. Investment figures point to digital health as a booming sector of the healthcare industry with high growth potential.

These trends have been in no small part due to the global coronavirus pandemic, accelerating a fundamental change in the way patients and clinicians access and deliver healthcare. Globally, health data is now largely digitised in the form of electronic health records (EHRs) and, through necessity, there has been an increase in patient and healthcare practitioner awareness and acceptance of digital health solutions. However, despite this staggering cash influx into a nascent space, experts argue that we are still in the early stages of the digital health boom (Forbes, 2022)⁴.

Partnerships

Digital health is underscored by collaboration and actionable information. Businesses in Ireland are creating a new age of digital health solutions with digital health companies working with medtech, biopharma, and technology companies to offer their perspective on creating the latest digital health products and services, as well as ensuring market access. With cross-sectoral partnerships in Ireland already forged by a well networked ecosystem, many companies are using Ireland as a testbed for going global.

Data sharing and interoperability

Another crucial area for digital health in the EU, and beyond, are the matters of data transfer and interoperability. Cross-border data flows are an essential part of digital health infrastructure as we plan for the future. Avoiding a drift towards data localisation in Europe will reduce the risk of restriction on cross-border trade. Beyond the EU, Ireland can support best practice sharing and business predictability with key partners such as the UK and US.

Regulatory affairs

Obtaining market compliance for digital health requires an understanding of the range of regulations which apply in the EU such as the Medical Device and IVD Regulations, Health Technology Assessment, General Data Protection Regulation, EU regulatory system for medicines, Digital Single Market, Artificial Intelligence Act, European Health Data Space and the Cyber Resilience Act. While the EU's reputation for compliance will help foster trust with the general public, and end-users, the US Food and Drug Administration benefit from its capability to streamline its approach to empower stakeholders to foster innovation with its 'Digital Health Center of Excellence'.

Reimbursement

Another key area of expertise for digital health adoption is reimbursement. In Europe, nearly 11% of gross domestic product (GDP) is spent on healthcare with pharma accounting for 15% of this, and 7.6% is spent on medtech (The European Medical Technology Industry in Figures 2022⁵). Economic evaluation has been widely applied to pharmaceuticals as there is usually a clear decision making process for including drugs on national or local formularies, on the other hand reimbursement for medical devices is usually through a broader process of financing hospitals or compensating clinical professionals. Healthcare is a decade behind digitising as illustrated in the OECD 'Health in the 21st Century' publication⁶. Reimbursement policies are needed that adequately foster the adoption of digital health solutions that improve outcomes, with guidance from national health authorities such as The National Institute for Health and Care Excellence in the UK and Centers for Medicare & Medicaid Services in the US to understand which mechanisms successfully incentivise the development of digital health.

Business environment

At a national level, governments play a major role in creating industrial policy that not only ensures but advances competitiveness. Clusters are increasingly created to connect key supports and stakeholders with the right governance to promote both vertical and horizontal collaboration. Notable examples include, France, Israel, and the United Kingdom, which are all investing heavily in the life sciences and digital health industries to accelerate the transformation of healthcare to deliver better outcomes, whilst growing the economy.

Ecosystem development

While the digital health sector in Ireland is in its infancy, the country possesses the perfect ecosystem to capitalise on these emerging digital health markets, given its strong positioning in medical devices, ICT, and biopharma.

1.3 The business model and the strategic imperative for collaboration

As part of Ibec’s campaign ‘Where Digital Health Thrives’ 200 companies which are already delivering digital health solutions in Ireland have been mapped across various market segments: telehealth, data, analytics and cyber security, remote monitoring, connected medtech, mobile health and more⁷.

There is consensus across the industry that digital health is becoming a key strategic imperative for both medtech and pharma organisations. Figure 1.1 illustrates notable digital health partnerships and acquisitions in medtech - it is evident that the digital health opportunity spans the entire continuum of the patient journey.

During the global pandemic, the medtech industry was forced to re-invest into research and development to digitise legacy technology. As an example of this, during the early phases of the pandemic, Medtronic rolled out software updates for its ventilators that would enable hospital personnel to operate the machines remotely, thereby minimising exposure to coronavirus⁸.

The pandemic also drove shifts in investment trends across the medtech industry. Investment trends point to In Vitro Diagnostics (IVD) as the medtech segment attracting the highest level of venture capital funding in the last decade (US\$ 40,124 M) followed by Healthcare IT (US\$ 36,626 M).

There is consensus across the industry that digital health is becoming a key strategic imperative for both medtech and pharma organisations.

Furthermore, the IVD segment saw an increase in the average investment deal size from USD 14 M in 2019 to USD 28 M in 2021, responding to the demand for diagnostics testing globally under the pandemic. As public need for, and acceptance of, digital health technologies such as telehealth increased, digital health companies with offerings in the areas of telehealth, digital therapies and home-based treatments attracted some of the biggest funding rounds in the first half of 2021. Cardiovascular devices, general surgery, diagnostic imaging, orthopaedic devices, and drug delivery devices have attracted significantly less investment in the past decade⁹. In the last five years in particular, AI-based technologies (e.g. computational pathology company PathAI) have attracted significant venture capital⁹.

Leading biopharmaceutical executives are now willing to invest in digital innovation to stay competitive, and certain digital technologies are already being widely adopted across biopharmaceutical organisations including AI, data lakes and wearable technologies.

Figure 1.1: Recap of notable digital health activity in medtech across the patient journey

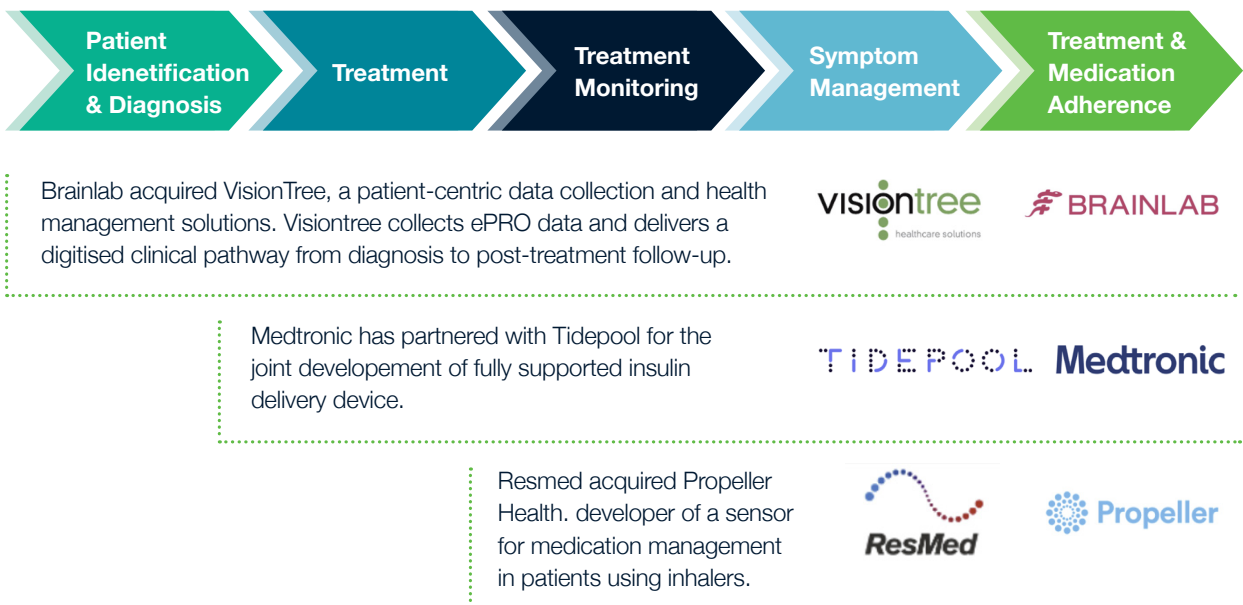


Figure 1.2 highlights notable partnerships between digital health and pharma companies that have made significant headlines over the past number of years. Similar to the examples in Figure 1.1, pharmaceutical companies are able to leverage digital health technologies to improve the patient (and HCP) experience throughout the care continuum.

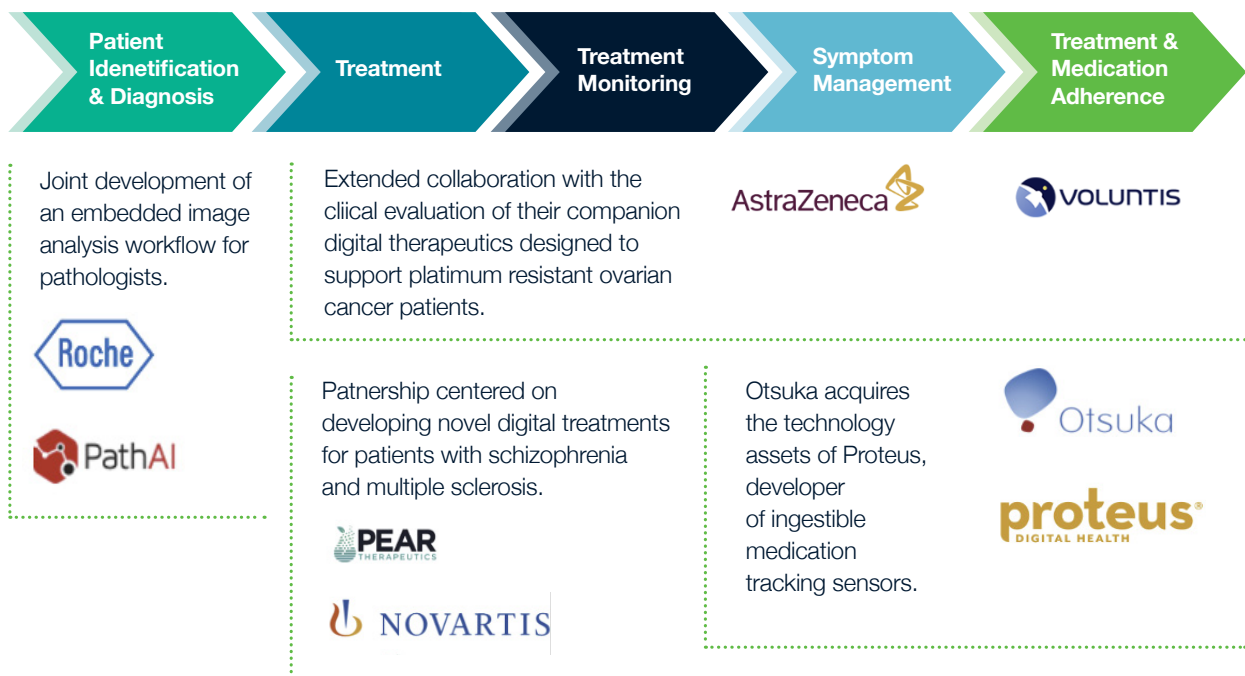
A report analysing the digital health maturity of the top 10 pharmaceutical companies in the time period 2014-2019 found that, in total, leading pharma invested USD \$833M in 2018, whereas in the US alone, in that same year, 395 digital health venture deals were struck amounting to over USD \$8B (HealthXL, 2019¹⁰, Rock Health 2022¹¹).

However, the global pandemic forced the pharma industry to pivot significantly from its traditional model of conducting clinical trials (and business more generally). At the outset of the pandemic, many pharmaceutical companies were forced to halt their clinical trials. Investment in remote technologies and capabilities allowed many companies to resume (or start) their research efforts. The successful conduct of the Pfizer Covid-19 vaccine trials has been attributed to the adoption of virtual trial monitoring technology¹² (Pfizer 2022).

Additionally, pharma has increasingly begun to explore DTx solutions. A recent industry report highlighted that partnerships between pharma and DTx have steadily increased over the last 5 years, the majority of which focused on combination-DTx compared to standalone DTx (67% vs. 29%, respectively). The opportunity for pharma in DTx solutions lies not only in the added value that a digital wrapper to existing assets brings to the patient and healthcare professional, but also the value of the real world evidence (RWE) that is generated from the digital solution. The RWE has many applications valuable to pharma from synthetic control arms to label-extension¹³.


While the medtech and pharma sectors are certainly increasingly engaging with the wider external digital health ecosystem, they have only started to scratch the surface. From a digital transformation standpoint, the medtech industry has traditionally been ahead of pharma. This is largely due to the fact that, as an industry, medtech has been focused on the connectivity of devices for a long time. However, for many medtech companies this has not directly translated into a “digital [health] DNA”¹⁴. In fact, despite industry-wide strategic incentives, the medtech and pharma sectors are laggards in terms of digital transformation. This is particularly true when compared to other sectors such as finance and retail¹⁵ (McKinsey 2021; IQVIA 2021).

Figure 1.2: Recap of notable digital health activity in pharma across the patient journey

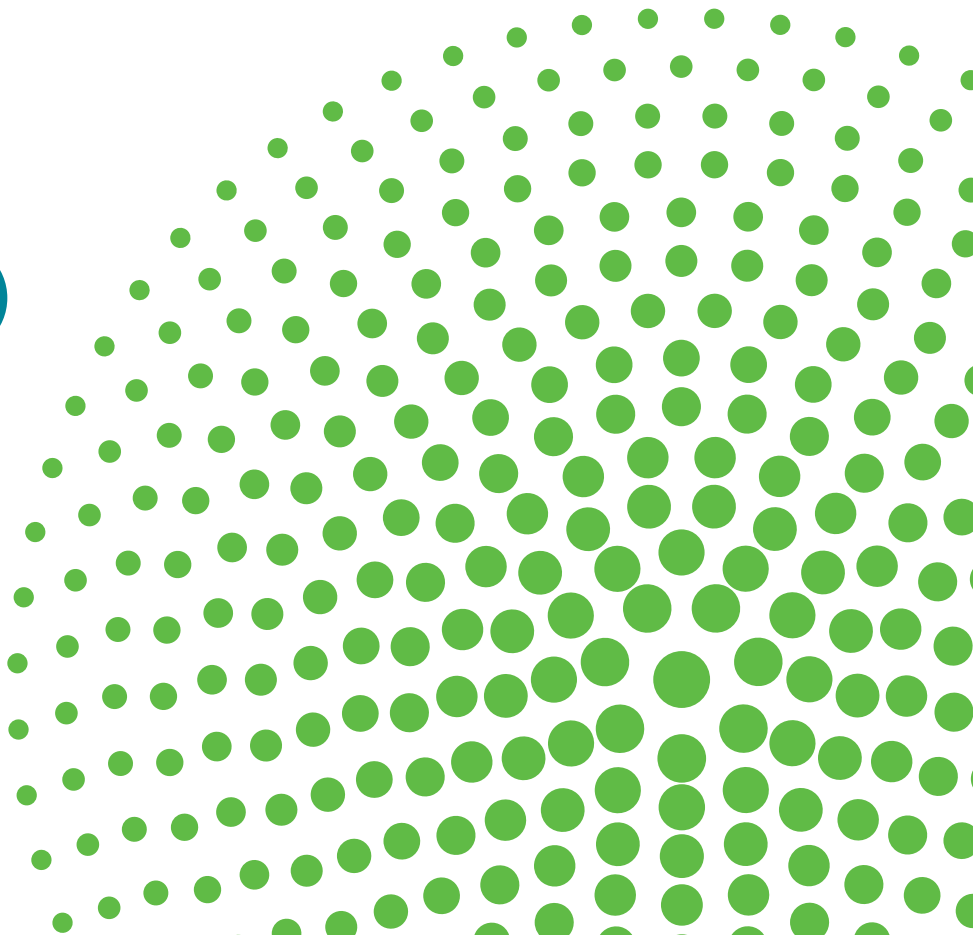
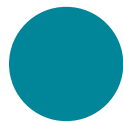


A recently published survey revealed that, according to industry experts and observers, the main trending topics across the digital health industry will be “artificial intelligence (57%), digital therapeutics (44%), and digital health ecosystems (42%)” followed by telehealth (37%) and remote patient monitoring (37%)¹⁶ (Research2Guidance, 2022).

As both the medtech and pharma sectors begin to increasingly invest in digital health technologies, there will be a need for skills enabling the development and implementation of digital health solutions. Skills needed for the future digital health workforce will include (combinations of) technical skills required for product development (such as software engineering) and empirical knowledge (e.g. regional regulatory standards for digital health solutions). True industry leaders will also need to exhibit skills such as strategic thinking and intra- and entrepreneurship that allow them to lead, execute and oversee digital transformation¹⁷.



Leading biopharmaceutical executives are now willing to invest in digital innovation to stay competitive, and certain digital technologies are already being widely adopted across biopharmaceutical organisations.



Section 2

**International
insights on digital
health industry
roles and skills
needs across
sectors**

This section analyses the digital health workforce composition based on a sample of 968 digital health roles drawn from the US, the UK and Ireland.

2.1 International insights from desk research on digital health industry workforce

The primary objective in conducting this analysis is to identify skills gaps which need to be addressed through the development and delivery of industry driven education and training programmes, as well as policy initiatives to support the development of a world class digital health talent pool to support the ecosystem in Ireland.

To first understand skill requirements, international research was undertaken using the United Kingdom (UK) and the United States (US) for comparisons as similarly structured economies that are also English-speaking. These two countries are renowned early adopters of digital health and are leaders when it comes to bringing a product from R&D through to commercialisation. Their experience helps us to understand the key roles and associated skill sets that are driving the digital health agenda in medtech, pharma and start-ups internationally.

The UK Digital Health ecosystem benefits from world leading universities, particularly in London, Oxford and Cambridge. These universities foster talent as well as having a legacy of successful research spinouts.

The US, is globally regarded as having a leading digital health ecosystem, supported by federal government regulations as well as financial incentives. Additionally, the US has a thriving digital health start-up ecosystem. Initiatives to train the healthcare workforce in digital health are also emerging in the US. Several medical schools are housing centres for digital health, offering certificate programs to upskill the digital health workforce.

Unlike the UK and the US, many companies in Ireland are primarily focused on international exports; Ireland's global lifesciences hub is a major driver of the Irish economy in turn stimulating both major investments and the addition of high-value, skilled jobs.

To better understand the current composition of the digital health workforce, we compiled and analysed a dataset of 968 current digital health roles across a selection of top-tier medtech and biopharmaceutical companies with good representation in Ireland, the UK and the US, as well as notable digital health companies/startups and incubators/accelerators in each of these countries. The dataset includes,

- 186 digital health related profiles working in the biopharma industry across the three regions,
- 153 working in medtech,
- 498 working in digital health companies and start-ups with a further,
- 131 working in digital health accelerators and incubators.

Box 2.1: Digital health roles in medtech and pharma



Digital health roles across key sectors

Box 2.1, a product of our data analysis, outlines examples of digital health roles found in the medtech and pharmaceutical industries and illustrates the diversity of new roles. Considering digital health roles in medtech and pharma are a relatively new development, the examples selected illustrate how digital health has gained relevance across the breadth of medtech portfolio (e.g. radiology, robotics, surgery) and the industry’s value chain more broadly.

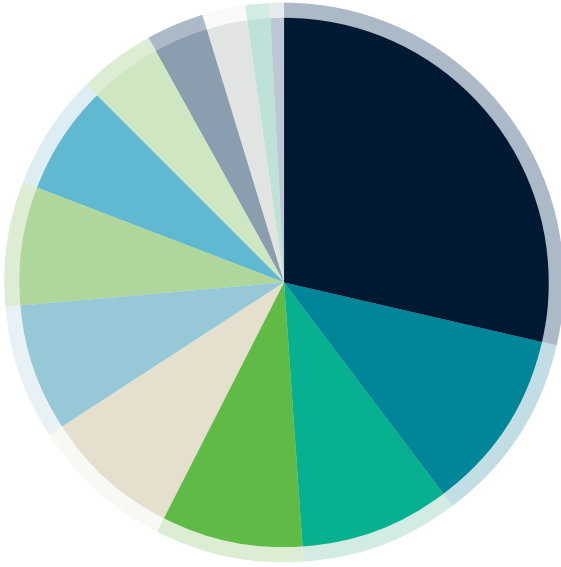
Similarly, in pharma digital health roles span the continuum of the pharmaceutical value chain. Roles related to ‘Digital Therapeutics, Market Access’ further suggest that pharma is looking in earnest at novel digital assets.

Box 2.1: Digital health roles in medtech and pharma (continued)



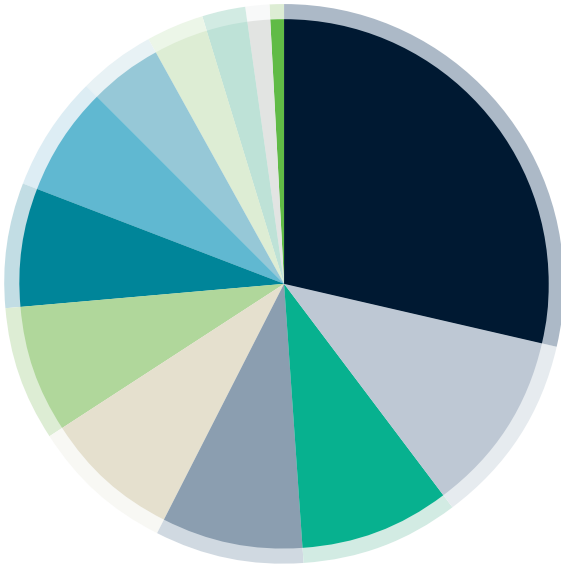
Figure 2.1: Categorisation of current digital health roles in the medtech and pharma industries (US, UK, IRL)

Current roles in medtech



- Digital & Broad Innovation – 44
- Product Development & Innovation – 17
- Business Dev & Customer Relations – 14
- Information Technology – 13
- Commercial – 13
- Management – 12
- Regulatory & Compliance – 11
- Data Analytics & AI – 10
- Other – 7
- Healthcare & Medical – 5
- Operations – 4
- Service Delivery – 2
- R&D – 1

Current roles in pharma



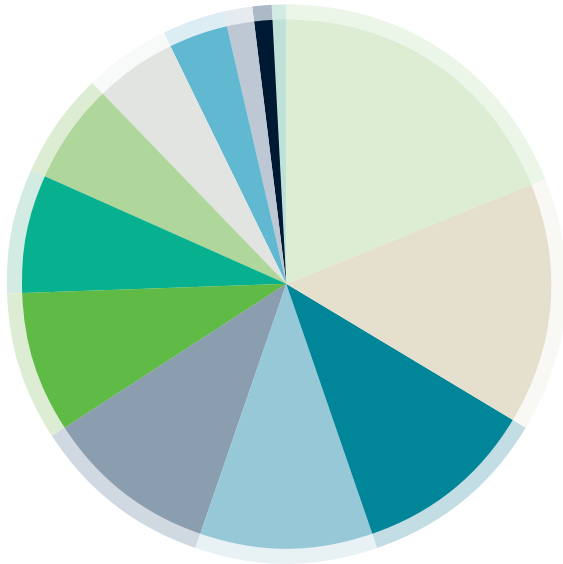
- Digital & Broad Innovation – 74
- R&D – 22
- Business Dev & Customer Relations – 20
- Healthcare & Medical – 16
- Commercial – 11
- Regulatory & Compliance – 10
- Product Development & Innovation – 8
- Data Analytics & AI – 8
- Management – 6
- Other – 4
- Service Delivery – 3
- Operations – 2
- Information Technology – 2

The majority of digital health roles in both the biopharmaceutical and medtech industry presently sit within the category of ‘digital and broad innovation’. (Figure 2.1) These tend to be leadership roles focused on strategy and partnership development. As digital health becomes more ingrained as a priority across these industries, the development of digital R&D capabilities is likely going to emerge as a key priority.

In comparison to those in pharma and medtech, the workforce in digital health companies/startups and incubators was much more diverse. For these sectors, the category of ‘other’ was significant as it comprises roles such as marketing in addition to positions such as board members and advisors. (Figure 2.2) Commercial roles were second most common, followed by R&D, product development and healthcare/medical expertise. Unlike in large multinationals, the co-location of a greater number of functions within a single country site is common for digital health companies.

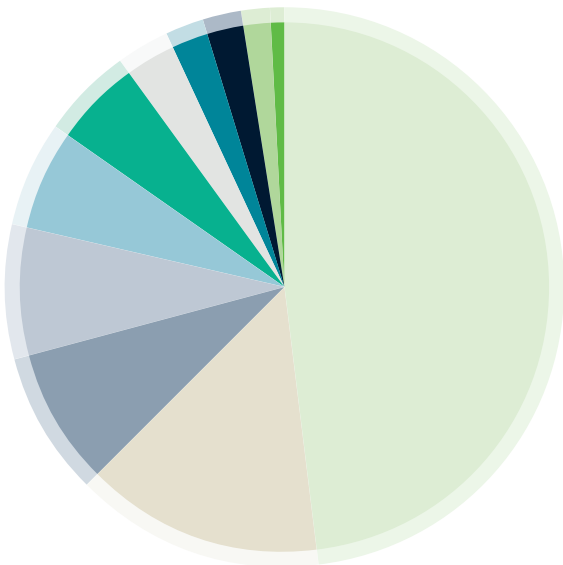
Figure 2.2: Categorisation of current digital health roles in the digital health companies/startups, accelerators and incubators (US, UK, IRL)

Current roles in startup



- Other – 95
- Commercial – 73
- Product Development & Innovation – 55
- Management – 53
- Healthcare & Medical – 52
- Information Technology – 43
- Business Dev & Customer Relations – 37
- Regulatory & Compliance – 30
- Operations – 25
- Data Analytics & AI – 18
- R&D – 8
- Digital & Broad Innovation – 6
- Service Delivery – 3

Current roles in incubators



- Other – 63
- Commercial – 19
- Healthcare & Medical – 11
- R&D – 10
- Management – 8
- Business Dev & Customer Relations – 7
- Operations – 4
- Product Development & Innovation – 3
- Digital & Broad Innovation – 3
- Regulatory & Compliance – 2
- Information Technology – 1

The majority of digital health roles in both the biopharmaceutical and medtech industry presently sit within the category of ‘digital and broad innovation’ and tend to be leadership roles focused on strategy and partnership development.

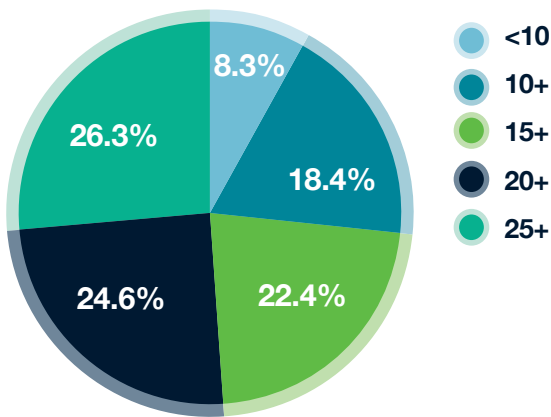
Level of professional experience

The career trajectory of the digital health workforce sample across the US, UK and Ireland was also analysed. The data shows that across the broad spectrum of digital health in the three regions, the workforce generally consists of hires with more than 10 years professional experience (Figure 2.3). In the US, digital health professionals most commonly have 25+ years of experience, while in the UK and Ireland, 15+ years and 20+ years are the most prevalent experience brackets respectively. Digital health ecosystem may favour more seasoned hires, potentially because they are better equipped to navigate such a nascent space.

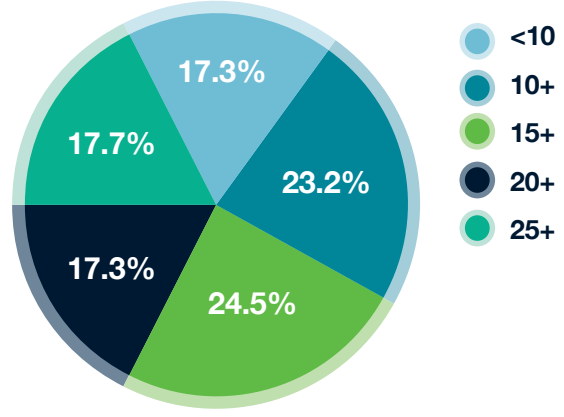
However, it could be argued that as digital health is at the forefront of healthtech transformation, hiring early stage talent could serve to push the boundaries of innovation. Of the three regions, Ireland shows the highest percentage of digital health hires with less than 10 years of experience, with over 21% of the workforce having up to 10 years' experience. The experience breakdown by sector reveals that most of these less experienced hires work in Ireland's thriving start-up sector, while both pharma and the medtech industry tend to favour more tenured hires.

Figure 2.3: Years of work experience in the current digital health workforce sample dataset

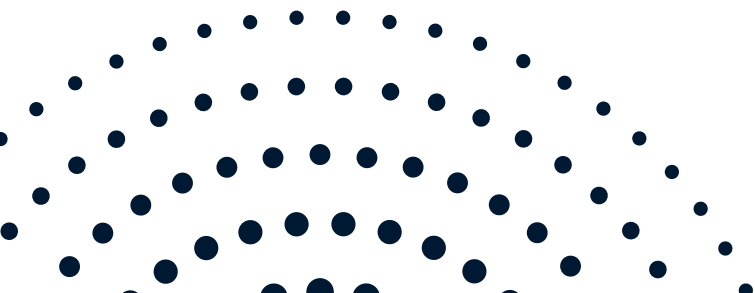
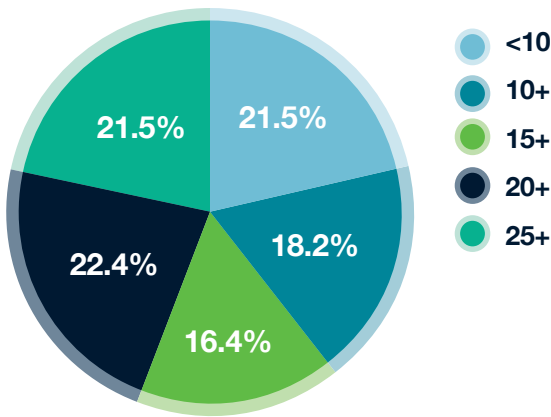
US: Total years of professional experience



UK: Total years of professional experience



Ireland: Total years of professional experience



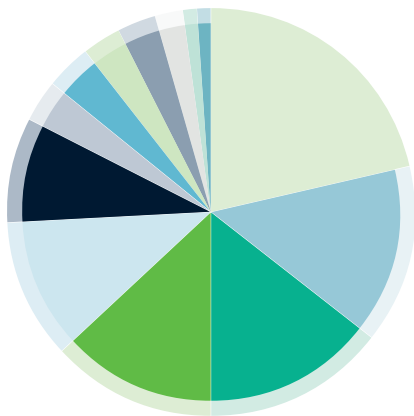
Previous roles

Further analyses were conducted to understand the previous roles held by the cohort of digital health employees. In the US, business development roles, management roles, project management and computer and data science roles were the

most common backgrounds from which the current digital health workforce was hired. Interestingly, only 10% of the US digital health workforce had previously held a role in digital health. While in the UK and Ireland 8.3 % and 13.5% held such a role respectively. (Figure 2.4)

Figure 2.4: Analysis of previous roles held by the current digital health workforce by country

Most recent previous roles (UK)



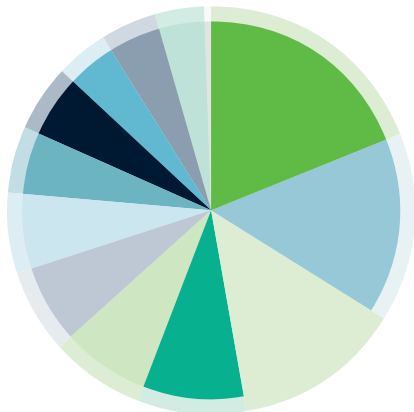
- Other – 49
- Management/Project Management – 33
- Business Development & Customer Relations – 33
- Computer & Data Science – 30
- Healthcare & Medical Affairs – 25
- Digital Health – 19
- R&D and Product Development – 8
- Consultancy – 8
- Marketing & Sales – 7
- Commercial & Operations – 7
- Project Management/Management & Finance – 5
- Academic Teaching – 3
- Quality & Regulatory Affairs – 2

Most recent previous roles (US)



- Business Development & Customer Relations – 86
- Other – 68
- Management/Project Management – 67
- Computer & Data Science – 51
- Digital Health – 49
- Marketing & Sales – 42
- Healthcare & Medical Affairs – 34
- R&D and Product Development – 26
- Quality & Regulatory Affairs – 25
- Commercial & Operations – 20
- Consultancy – 14
- Academic Teaching – 5
- Project Management/Management & Finance – 4

Most recent previous roles (Ireland)



- Computer & Data Science – 44
- Management/Project Management – 34
- Other – 31
- Business Development & Customer Relations – 20
- Marketing & Sales – 17
- R&D and Product Development – 15
- Healthcare & Medical Affairs – 15
- Quality & Regulatory Affairs – 12
- Digital Health – 12
- Consultancy – 10
- Commercial & Operations – 10
- Academic Teaching – 9
- Project Management/Management & Finance – 1

Educational attainment

An analysis of educational backgrounds revealed that across the three regions and sectors the most common qualification amongst the digital health workforce is the masters degree, with almost 42% of the Irish digital health workforce holding a postgraduate qualification. Analysis of the different subject areas of these qualifications show that the top two subject areas across the three regions were life sciences and management degrees. (Figure 2.6) High quality science, technology, engineering and mathematics (STEM) graduates are highly coveted in the healthcare industry as they demonstrate strong healthcare literacy amongst other relevant competencies upon which digital health training can be layered.

Considering Ireland’s position as a global leader in the development of medical technologies, it is ripe for the development of a thriving digital health R&D sector.

However this will require a greater emphasis on the development and upskilling of in-house talent across the pharma, medtech, and digital health industries. Connected Health Skillnet, supported by Skillnet Ireland, will play an important role in creating the industry centred and niche training interventions needed.

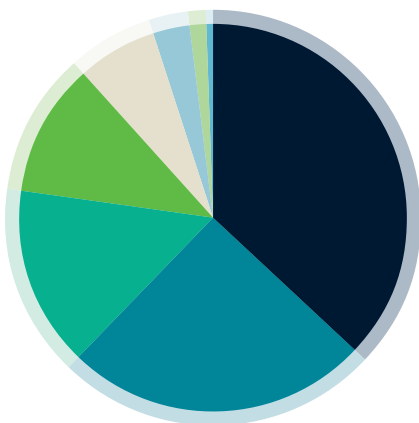
Digital health skills framework

This analysis of the dataset of 968 profiles working in digital health enabled us to categorise the types of digital health roles occurring across medtech, pharma and digital health sectors, as well as the professional and academic experience and skills of the candidates that fill these roles.

We used this analysis to construct a macro level **digital health skills framework** which is discussed in Section 3 of this report.

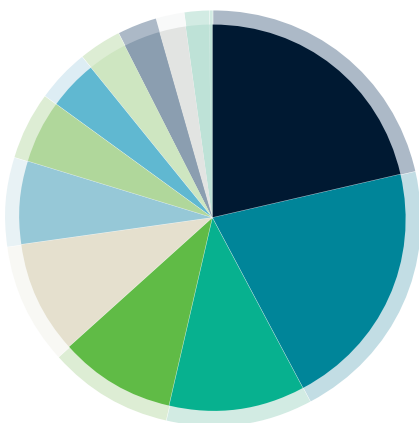
Figure 2.6: Educational background of the current digital health workforce

Most Common Highest Level of Education



- Masters Degree – 360
- Bachelor's – 244
- PhD – 144
- N/A – 108
- MBA – 64
- MD – 30
- Diploma – 15
- Postgraduate Degree – 3

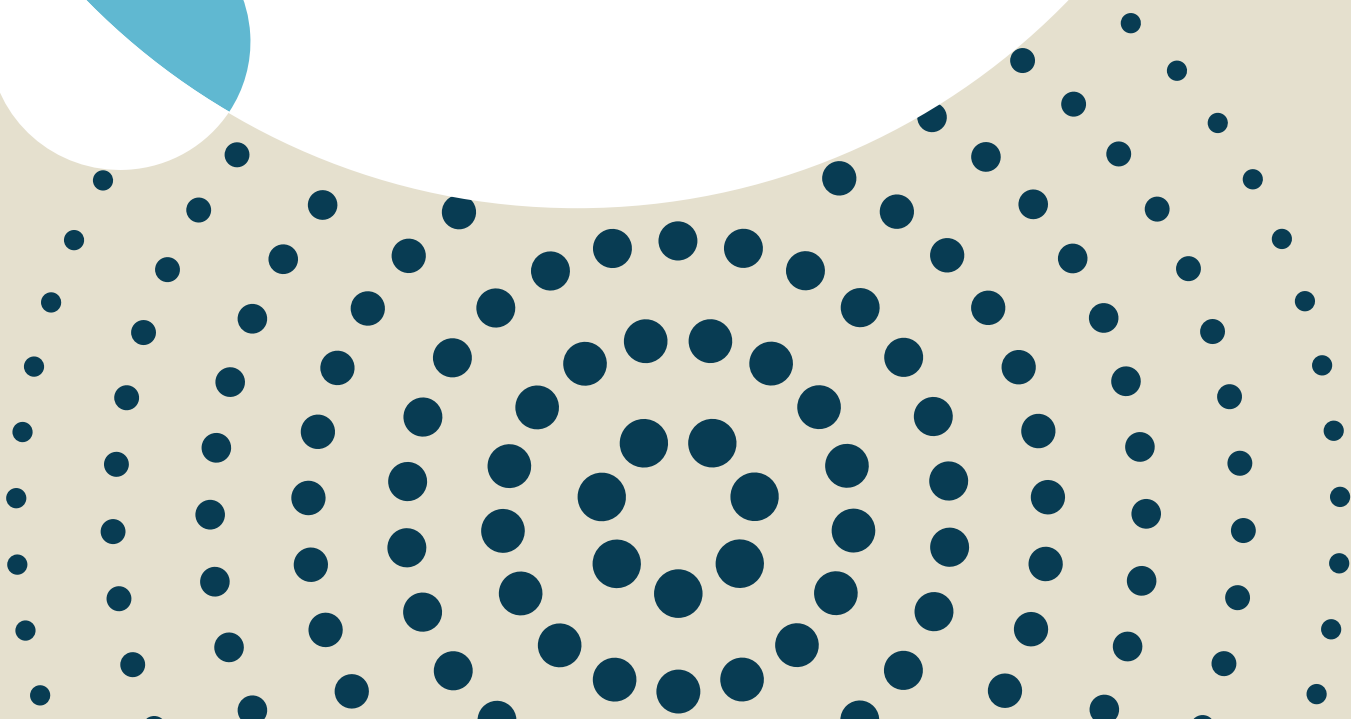
Education Subject Area



- Life Science & Medicine – 208
- Management – 202
- Engineering – 110
- N/A – 94
- Data & Computer Science – 91
- Other – 69
- Marketing/ Advertisement & Sales – 51
- Commerce & Economics – 40
- Law – 32
- Finance & Accounting – 28
- Behavioural Sciences – 22
- Journalism & Politics – 20
- Quality & Regulatory Affairs – 1

Section 3

A skills framework for the digital health sector



This section presents the digital health skills framework developed for the skills needs analysis for the Irish ecosystem.

3.1 A skills framework to guide the skills benchmarking analysis

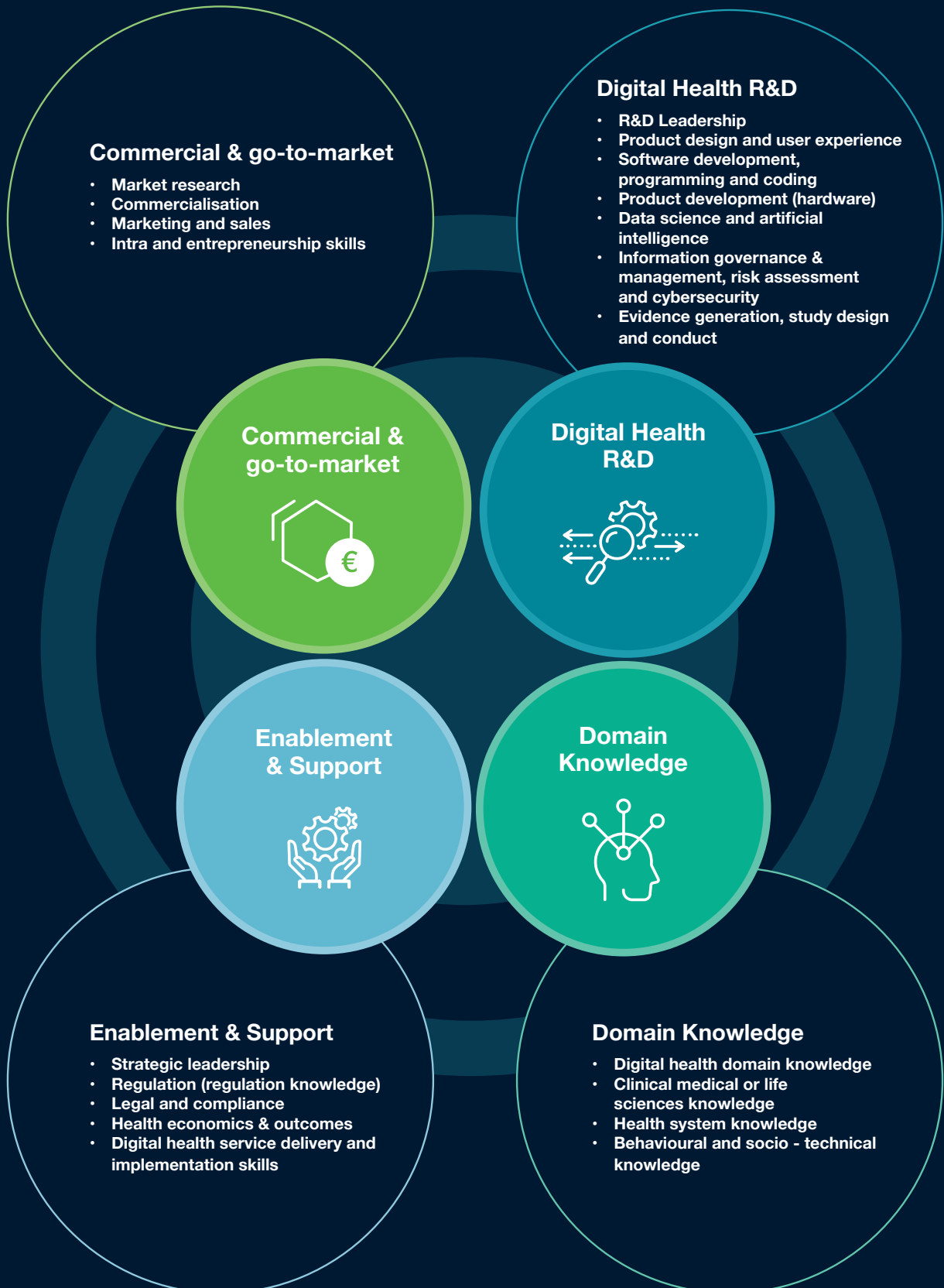
Recruiting top tech talent from across the life sciences industry (and beyond) is imperative to support a digital-first culture within medtech and pharma. Primary research for this work during multiple roundtable discussions highlighted the need to attract technology specialists to the healthcare industry. The idea of hiring a 'digital health generalist' vs a team of specialists was also discussed. Whilst the generalist reflects the profile of the digital health expert with knowledge of all stages of the product life cycle, from ideation through to commercialisation, such a profile is very rare given the nascency of the space. Rather, the life sciences industry must hire teams of specialists with a suite of competencies that compliment each other to drive the digital agenda forward.

In order to conduct a skills benchmarking and needs analysis for the ecosystem in Ireland, a skills framework was developed. Figure 3.1 covers the value chain in digital health and applies to digital health companies, as well as medtech and pharma companies seeking to launch connected products or otherwise digitise their product portfolios.

Recruiting top tech talent from across the life sciences industry (and beyond) is imperative to support a digital-first culture within medtech and pharma.

Figure 3.1: Digital Health Skills Framework

Digital Health Skills Sets - Macro Framework



The digital health skills framework (Figure 3.1) is anchored around four key pillars. Each pillar subsumes a core set of macro skills, that is a broad set of skills and expertise:

1. **Digital health R&D:** This pillar refers to the technological skills that are required for software or connected product development, and digitalisation of existing product portfolio. This differs from regular tech development skills as the healthcare ecosystem, their products and data are highly regulated. Developers need to be able to navigate the complex regulatory landscape in order to build in the healthcare space.
2. **Domain knowledge:** Domain knowledge refers to the detailed knowledge of digital health, clinical, medical and life sciences domains, in order to identify opportunities for digital health in their relevant domain. This pillar also includes a wider understanding about how patients interact with digital technologies in different socio-economic environments.
3. **Commercial and go-to-market:** This pillar of skills includes those required to bring a digital health solution to market. As already mentioned, the digital health space is a highly nuanced and regulated subset of the broader technology field. The customers of digital health include health systems, HCPs, patient's and life sciences companies. As such, the commercialisation strategies for digital health products require specific knowledge of this complex space in order to effectively bring a product to market.
4. **Enablement and support:** The final pillar of enablement and support encompasses skills which facilitate the implementation of digital health solutions. Skills in this bucket include those around strategic leadership in digital health, specific regulatory and legal knowledge, evidence generation for digital health solutions, as well as service delivery and implementation capabilities for this highly nuanced space and siloed space.



In order to understand the specific skills demands within the Irish ecosystem, a further skills layer was added to the framework. Each macro category is further broken down into core sets of meso level skills. Meso level skills are smaller, distinct skills, identified as a core skill associated under each higher order category. Following on with this analogy, micro skills are even more granular skills, tools or methodologies specific to the execution of the higher order skill. Having a complete understanding of the full spectrum of skills required for digital health is essential for developing the niche training interventions in this area.

The macro-meso-micro framework is the product of numerous interviews with industry leaders from the medtech, pharma and digital health ecosystem in Ireland, UK and US to identify the more granular skills required throughout the digital health product lifecycle. It will be used by Connected Health Skillnet to build out educational modules for upskilling the Irish digital health workforce. Programmes that are built through industry consultation will ensure that the learning outcomes are aligned with industry needs, so that the new skills and competencies developed match those required by employers. An example of this principle can be seen in Figure 3.2.

Digital health R&D

Figure 3.2: Example of Macro - Meso - Micro Skills Nesting in Digital R&D (Further detailed information is available from the Connected Health Skillnet)

Macro skill	Expert validated meso skill	Micro skill example
Data science and artificial intelligence	Neural networks and reinforcement learning	Tensorflow Pytorch

The digital R&D pillar maps the broad technological skill sets required for the spectrum of R&D roles of a digital health product across the pharma, medtech and digital health sectors. Figure 3.2 uses data science and artificial intelligence as the selected macro skill to demonstrate this nesting principle. Within this subject category, understanding how neural networks process data for reinforcement learning, a core paradigm for machine learning, is considered a sub-skill, and sits at the meso level. Examples of micro skills within this space include knowledge of tensorflow and/or pytorch, two popular deep learning frameworks. They are both open source python libraries used by developers to perform numerical computation on data. The micro skills category designates highly specific skill sets, such as usage of specific tools, that sit within the broader macro-meso knowledge areas.

For each of the four pillars in Figure 3.1, a comprehensive macro-meso-micro framework has been constructed. The examples which are highlighted throughout this section are to give an idea of the framework on which we structured this report. Connected Health Skillnet will use this framework to inform the strategic development of a suite of new training programmes to address key skills areas for the Irish ecosystem which have been identified during this analysis. Once such example is the upcoming Digital Health Innovation Programme (developed by Connected Health Skillnet) which aims to address the growing demand for a proven innovation training methodology in digital health.

Domain knowledge

Domain knowledge in the skills framework refers to the digital, clinical, medical and life sciences expertise required to identify the need and value proposition for a specific digital health solution. It also includes health systems knowledge as well as behavioural and socio-technical knowledge amongst patient populations. This pillar is particularly important for ideation and innovation within the life sciences industries. An example of the macro-meso-micro nesting in the domain knowledge skill set can be seen in Figure 3.3 using behavioural and socio-technical knowledge is explored as the macro skill. A meso or sub skill of this is understanding how users interact with technology in different healthcare-related environments. As this is a specific application of a broader transferable skills, no further breakdown into micro skills was required.

Figure 3.3: Example of Macro - Meso - Micro Skills Nesting in Domain Knowledge (Further detailed information is available from the Connected Health Skillnet)

Macro skill	Expert validated meso skill	Micro skill example
Behavioural and socio-technical knowledge	Understanding of how users interact with technology in different healthcare-related environments	Specific application of a broader skill set. Transferable skill that can be translated across sectors.

Commercial and go-to-market

Commercial and go-to-market skills represent the third overarching pillar of our skills framework. In this bucket we have categorised all the skills required to sell digital health products to their intended user, including strategy and market research, marketing and sales and intra-and entrepreneurship. An example of the macro-meso-micro principle using marketing and sales as the selected macro skill can be seen in Figure 3.4. One of the meso skills for the topic is knowledge of commercial channels for connected health. Breaking this down even further into micro skills would yield knowledge of D2C and B2B approaches for connected health.

Figure 3.4: Example of Macro - Meso - Micro Skills Nesting in commercial go-to-market (Further detailed information is available from the Connected Health Skillnet)

Macro skill	Expert validated meso skill	Micro skill example
Marketing and sales	Commercial channels for connected health	- B2B approaches for connected health - D2C approaches for connected health

Enablement and support

Enablement and support, the final pillar of our digital health skills framework, describes the skills required to facilitate the implementation of digital health solutions. This includes the broader macro skills of regulation, legal, evidence generation and service delivery. Taking regulation as a selected macro skill in this pillar, a meso skill breakdown is Software as a Medical Device (SaMD) regulation, with knowledge of EU medical device regulation, or CE mark classifications being a micro skill in this subject (Figure 3.5).

Figure 3.5: Example of Macro - Meso - Micro Skills Nesting in enablement & support (Further detailed information is available from the Connected Health Skillnet)

Macro skill	Expert validated meso skill	Micro skill example
Regulation	SaMD Regulation	- EU medical device regulation - CE mark classifications

3.2 Digital health archetypes

As the digital health industry is still in its nascency, there is no traditional career path that individuals follow for a career in digital health. As adoption of these technologies grow, the typical career trajectory for digital health is likely to become more established. This variation in career paths was also evident in our data set of 968 digital health roles across the US, UK and Ireland. As can be seen in Figure 3.1, there is a large variation in the types skills that are required by the digital health industry, spanning digital R&D, domain knowledge, commercialisation, and enablement and support. However, we did spot some similarities and trends emerged when focusing specifically on digital health in life sciences industries. By taking select examples of digital health leadership roles in both the pharma and medtech industry, a digital health ‘archetype’ was mapped out for each industry. similarities can be seen across the two select career pathways.

Archetype A (Figure 3.6) maps out the career path of a ‘senior director in digital’ for a global pharma company. Their formal education lay in computer science, having both a bachelors, and masters degree in this area. During this time one could assume that they acquired digital R&D knowledge, such as software development, advanced analytics and information and risk management and cyber security.

Their most recent position as ‘director of digital health and technology’ at a pharma company would likely have built on this skillset, whilst also developing their health systems knowledge (domain knowledge) and intra- and entrepreneurship experience (commercial & go-to-market).

Their current position as ‘senior director in digital’ at a pharma company would likely expose them to strategic leadership and service delivery and implementation, both of which sit in the enablement and support pillar.

Figure 3.6: Digital Health Archetype - Pharma industry

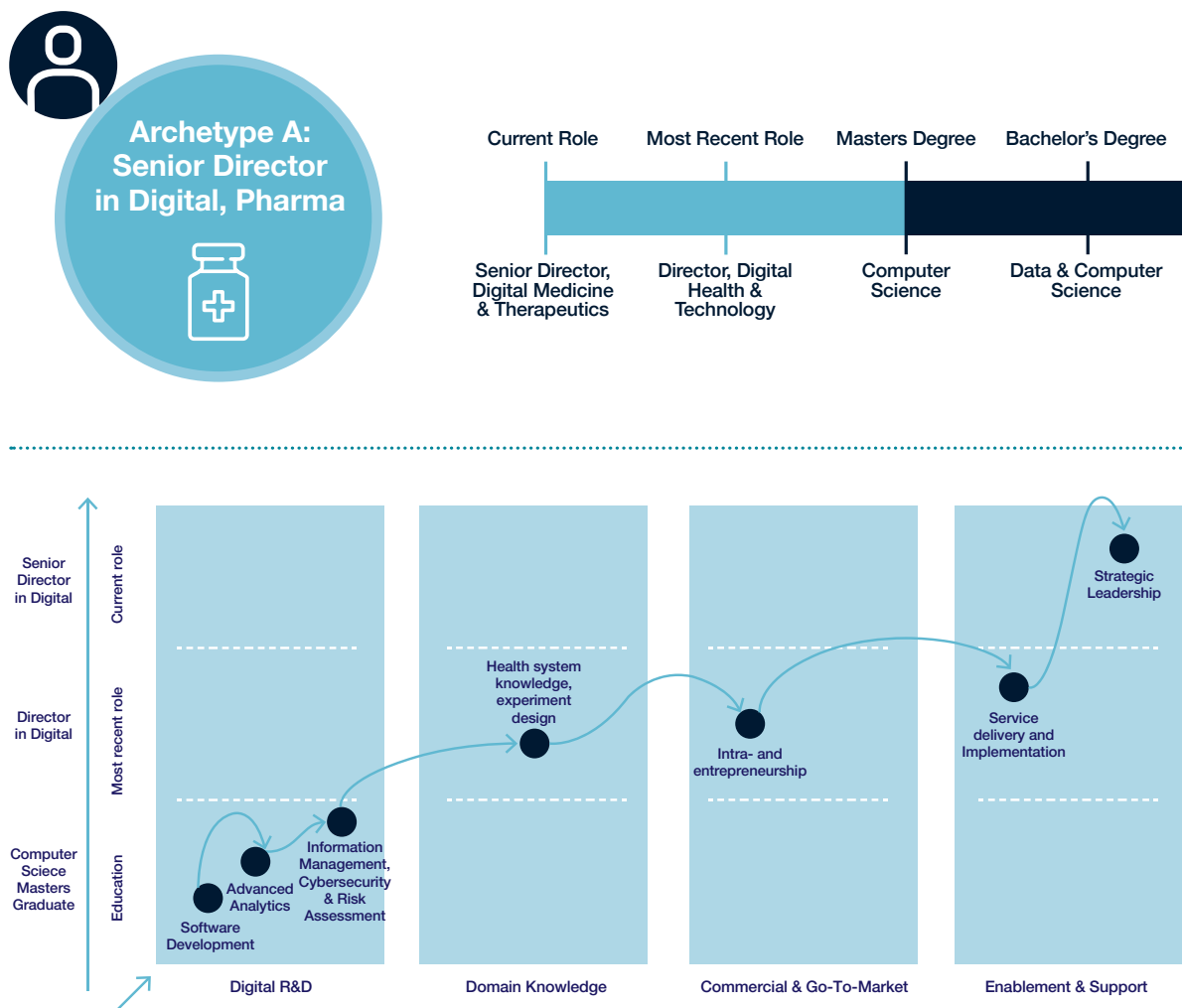
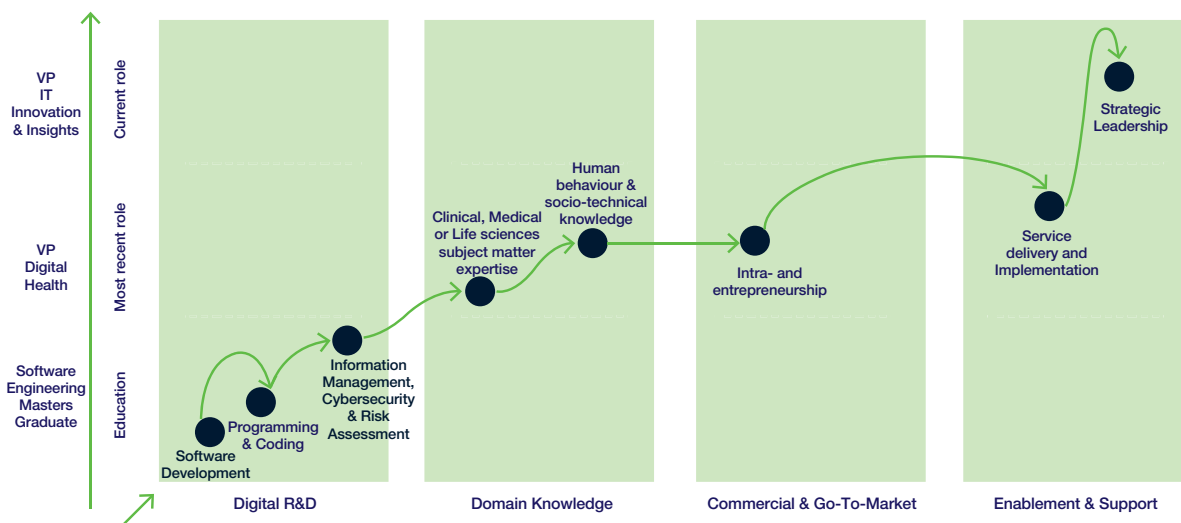
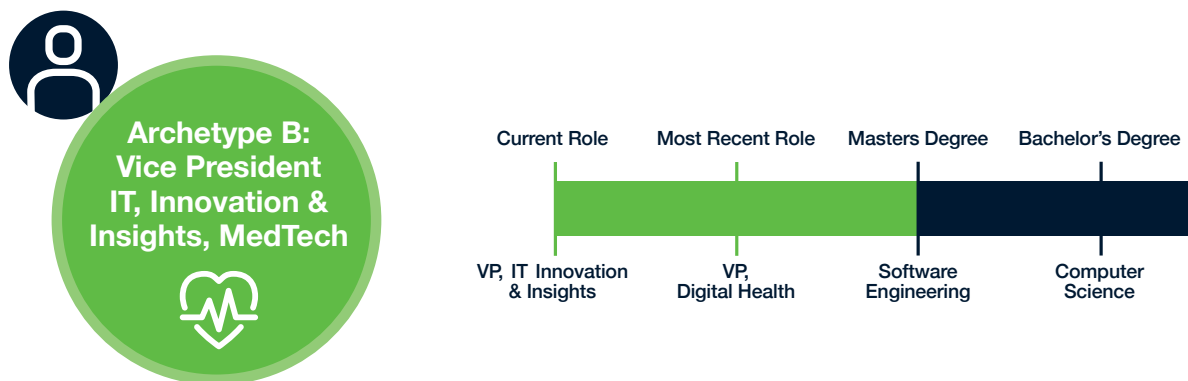


Figure 3.7: Digital Health Archetype – medtech industry



Archetype B (Figure 3.7) maps out the career path of a ‘VP, IT innovation and insights’ for a global medtech company. Our dataset shows that they began their career with a bachelors in computer science and a masters in software engineering, laying the foundations of their digital R&D skills. Their most recent position as a medtech ‘VP of digital health and technology’ would likely have built on this skillset, whilst also developing the necessary clinical medical and life sciences knowledge, health systems knowledge and human behaviour and socio technical knowledge (domain knowledge) and intra- and entrepreneurship experience (commercial & go-to-market).

The skills framework discussed in this section was used to benchmark the Irish and international digital health workforces, and an industry survey helped to identify key skills requirements in the Irish digital health workforce in the coming years.

Career Case study



Lara Kelly

VP Data Analytics & Global Implementation,
HealthBeacon

Previous roles

- Head of Data Analytics & Implementation, HealthBeacon
- Project Manager, HealthBeacon
- Consultant, Accenture

Education

- BA, BAI Mechanical & Manufacturing Engineering, Trinity College Dublin
- MSc Biomedical Engineering, Trinity College Dublin

How did you first hear about careers in digital health?

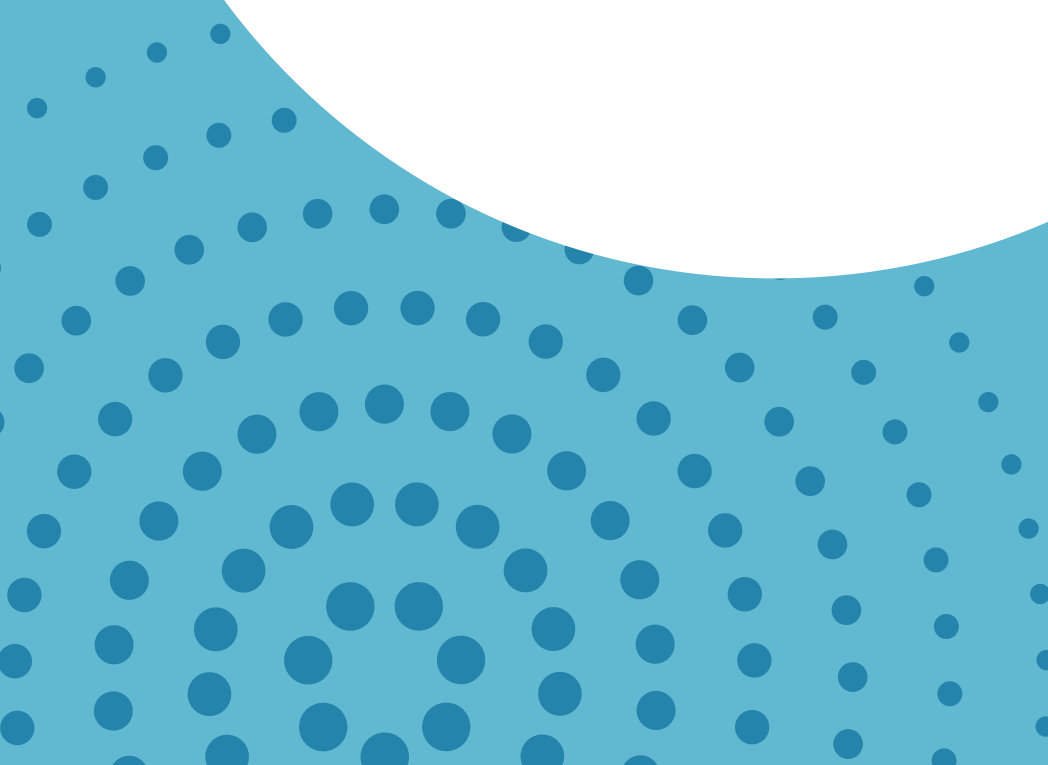
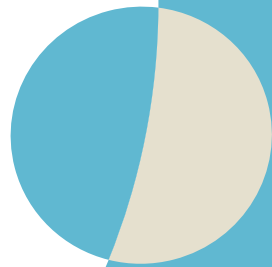
To be honest, I didn't have a clear plan to pursue a career in digital health. Initially, I wanted to become a doctor, but when I didn't get into the course, I turned to Engineering because of my love for science. While pursuing my master's degree in engineering, I became fascinated by the impact that technology could have on the healthcare industry. After spending time in the National Rehabilitation hospital learning about and experimenting with applications of technology in the healthcare setting there was no turning back! To learn more about the field, I attended several talks, contacted people in my network and through LinkedIn who were working in the industry in Ireland. Eventually I came across HealthBeacon and I knew it was the perfect fit for me!

What do you like about working in digital health?

The most rewarding aspect of my work in digital health is seeing that it has a tangible impact on people's lives. When we receive feedback from patients or clients about how our technology has helped them, it is amazing and serves as a reminder of what we do. Working alongside a team of passionate colleagues (both at HealthBeacon and within many of our partners organizations) who are equally passionate is also very motivating. It is exciting to be part of a community that is dedicated to improving the healthcare industry and make a difference to people's lives. Another aspect of my work that I find particularly enjoyable is the continuous learning and problem-solving that's involved. As we are introducing innovative technology that hasn't been used before, we were constantly faced with new challenges to solve. This requires us to be adaptable and flexible, and to work collaboratively across many sectors to find creative solutions. Every day is different!

Section 4

Benchmarking international digital health industry workforces



This section benchmarks and describes the skills of a US, UK and Irish digital health workforce sample.

4.1 Skills Analysis of the Digital Health Workforce

The purpose of this section of the report provides a benchmarking analysis of the Irish digital health workforce against two countries leading in digital health innovation and adoption: the UK and US. Having established the digital health skills framework (Figure 3.1), we revisited the dataset of 968 roles within the digital health ecosystem.

The skillset of each of these roles were mapped to the macro skills framework (Figure 3.1), using geographic lens, to provide a cross-regional skills analysis (Figure 4.1). Further to this, we mapped relevant skills to the career journey of each profile in the data set in an attempt to understand where these skills are most commonly acquired, be it in a previous role, or from education (Figure 4.2).

Given the novelty of digital health within the pharma and medtech industry, strategic leadership are coveted skills to manage the cultural shift that is required.

Figure 4.1: Skillset of the digital health workforce from our sample dataset, segmented by industry and country.

■ US
■ UK
■ Ireland



The skills composition across the three sectors of the digital health workforce as a whole, suggests that a higher percentage of the workforce occupies implementation roles (commercialisation and enablement and support) vs production (domain knowledge and digital health R&D) (Figure 4.1). The skills breakdown shows that strategic leadership and intra- and entrepreneurship are highly valued skills across the life sciences sectors. Given the novelty of digital health within the pharma and medtech industry, strategic leadership are coveted skills to manage the cultural shift that is required. Additionally, skills associated with intra- and entrepreneurship are important to navigate the new and unprecedented territory.

The data set indicated that there appears to be a lower level of exclusively digital health commercial roles in the Irish workforce in both biopharma and the medtech FDI multinationals when compared with the other regions (Figure 4.1), however this can be explained by differing business models, corporate structures and reporting lines. As previously highlighted, Ireland is a manufacturing and innovation powerhouse of the life sciences industries, with its products primarily exported and commercialised abroad. As the skills of the workforce will generally reflect the needs of a business, a lower proportion of commercialisation skills within the Irish workforce is expected.

Across all geographies, it would further appear that regulation, legal and compliance are less well represented within digital health workforces. While traditional regulatory skills are present in all locations, specific knowledge of digital health regulations are less well represented. Given the newness of digital health, the regulatory landscape surrounding production and implementation of these technologies is constantly evolving.

As it is a complex yet incredibly important landscape to navigate, the knowledge to do so presents a key development opportunity within the digital health workforce. Similarly, the evaluation of health and economic outcomes, especially as they relate to the deployment of digital health tools at a greater scale, is somewhat uncharted territory at present. Experts consulted for this project however commented that this skill is likely to experience high demand in the coming years and therefore presents a key development opportunity for the Network.

It would appear that regulation, legal and compliance are less well represented within digital health workforces. While traditional regulatory skills are present in all locations, specific knowledge of digital health regulations are less well represented.

Domain knowledge and digital health R&D skills are proportionally less prevalent across all sectors. Again, this speaks to the nascency of the space, with life science companies currently preferring to partner for this expertise, rather than acquire in house. As the landscape develops, and digital becomes embedded within company culture it is likely that the demand for in-house domain knowledge and digital health R&D will grow. This point was reinforced in expert interviews where many highlighted the difficulty of attracting those with a software engineering and cybersecurity backgrounds to the life sciences industry.

Looking at the skillset of the digital health/start-up ecosystem, the Irish workforce is much more competitive than both the UK and the US (Figure 4.1). Across all three regions strategic leadership is highly prevalent in the workforce, as are intra- and entrepreneurship, commercialisation and sales and marketing. Interestingly, Ireland dominates the other two regions when it comes to software development, advanced data analytics and information management/cybersecurity within this ecosystem. As these have been highlighted as key skills which will be necessary for the future of digital health, Ireland should continue to cultivate these skills to maintain this competitive edge and maintain core base skills from which to build digital health expertise. Additionally, Irish life sciences companies should mimic the efforts of the digital health ecosystem in attracting highly competitive R&D talent to digital health. User experience and evidence generation, however, are skills where the Irish workforce is lacking, thus presenting key growth areas for the Irish digital health workforce.

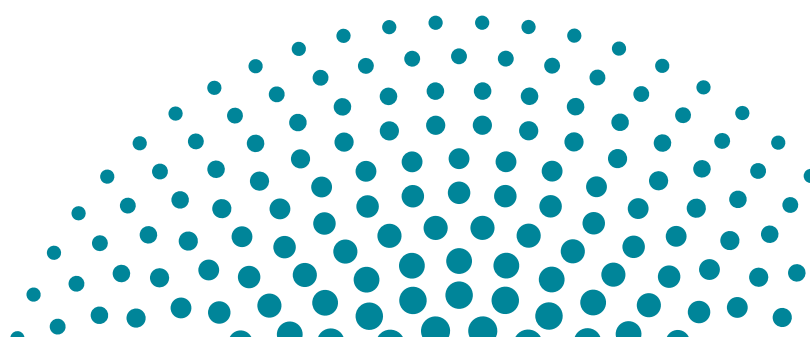
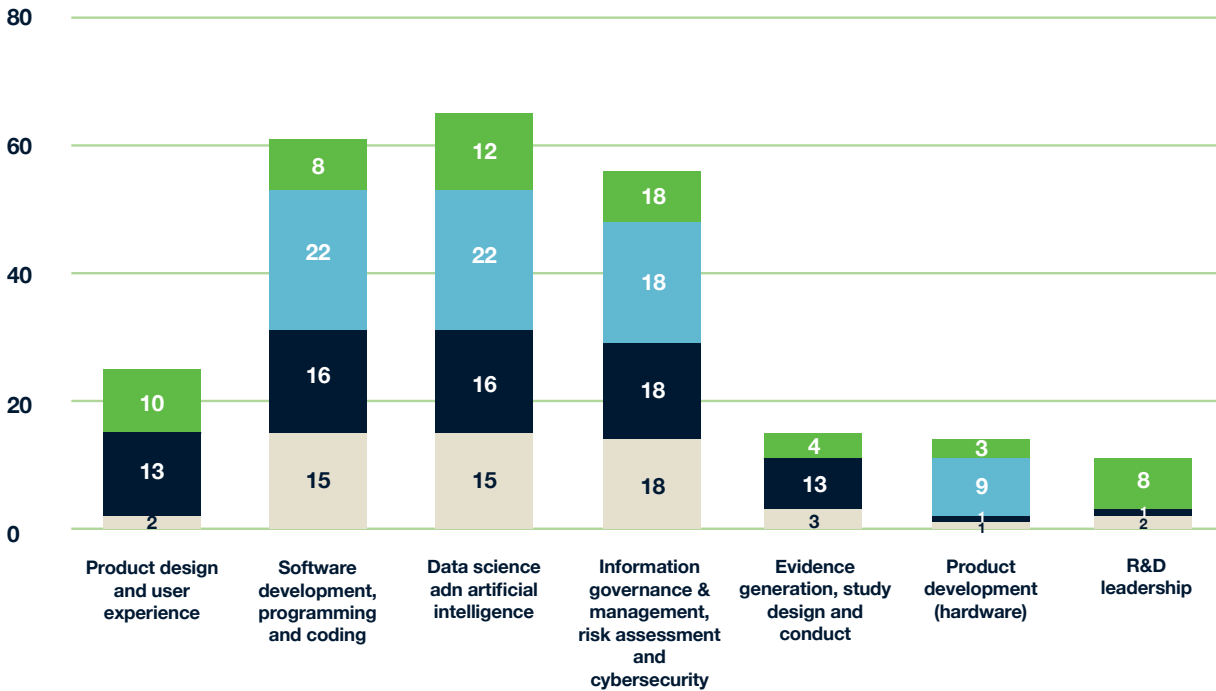


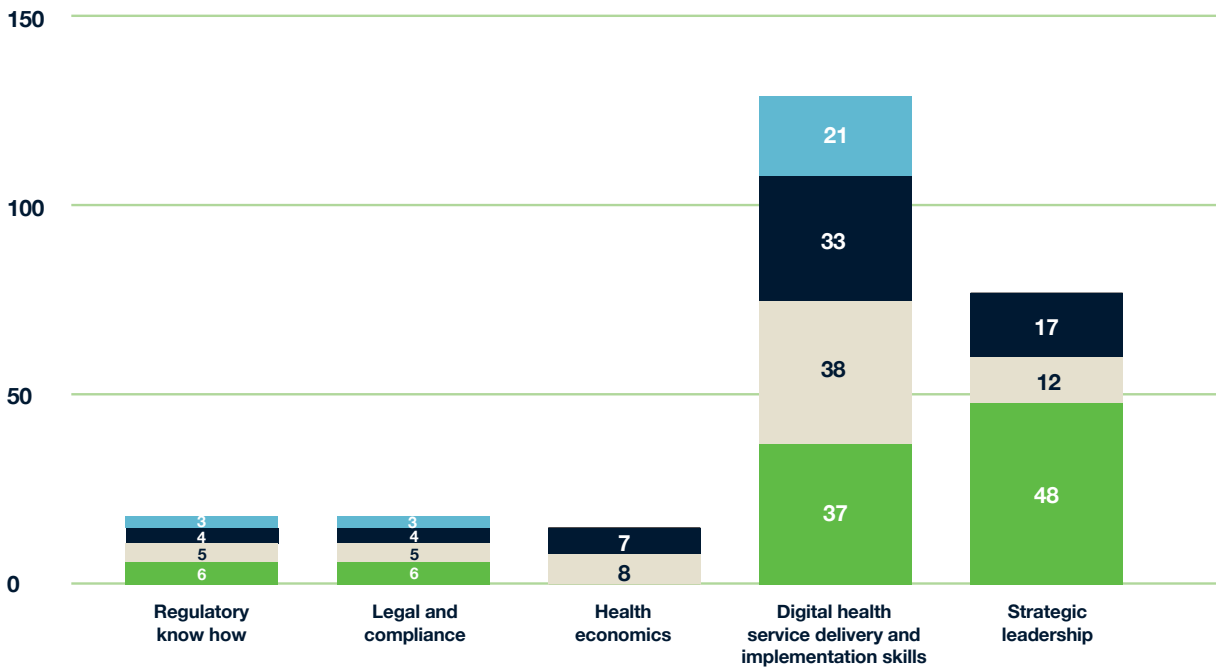
Figure 4.2: Origins of skillset of the digital health workforce

Education Previous
 Most Recent Current

Digital Health R&D

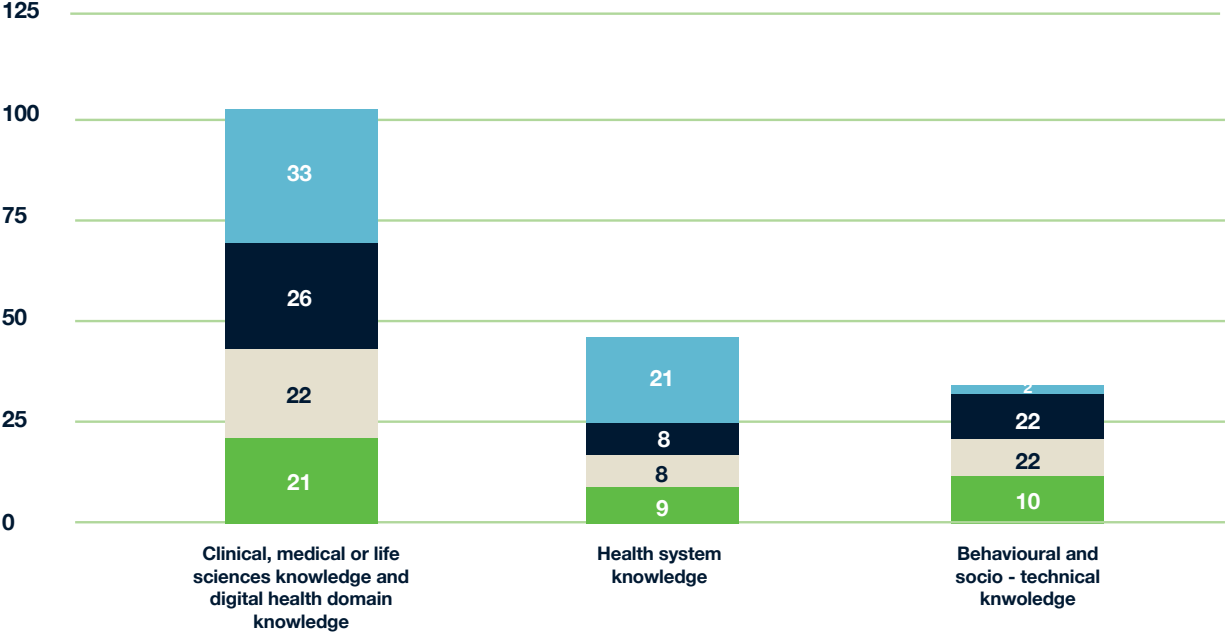


Enablement & Support

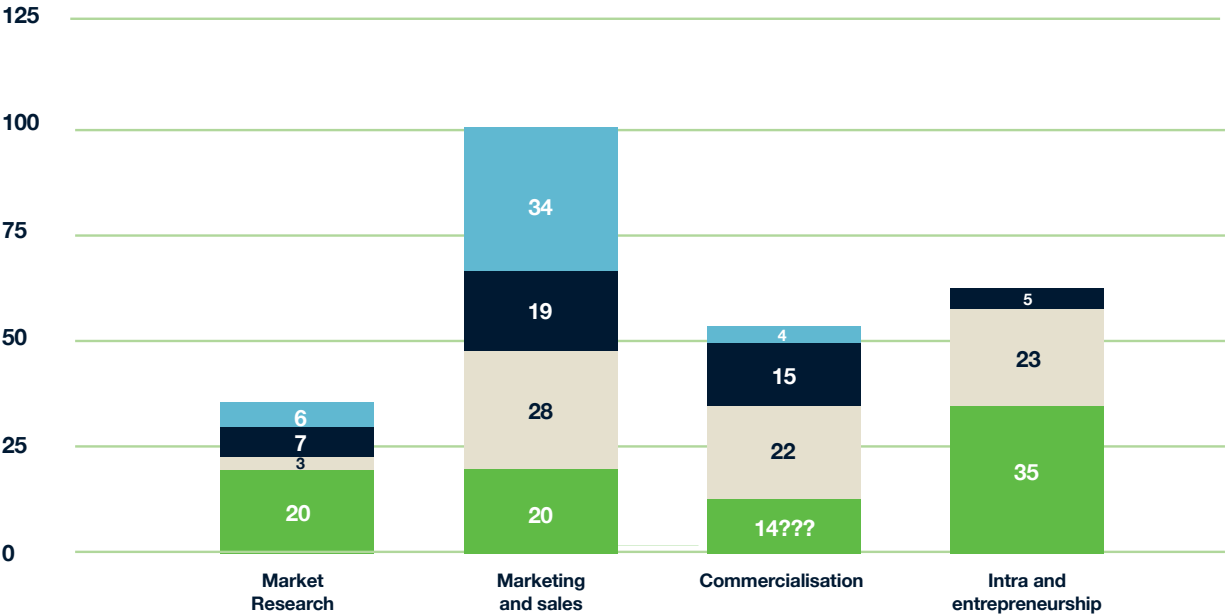




Domain Knowledge



Commercial & go-to-market



The analysis of the digital health workforce development pathway revealed that domain knowledge is a key core competency that is generally acquired through education and further developed on the job, as is much of digital health R&D, including software development, hardware development, advanced data analytics and cybersecurity. In contrast, the skills categorised under enablement and support as well commercial go-to-market are generally learned through on the job training. Figure 4.1 shows that strategic leadership and intra- and entrepreneurship skills are the most prevalent skills in the current digital health workforce. Figure 4.2 shows that both skills are often acquired through work experience, mostly within their current position.

Commercialisation along with sales and marketing for digital health products stood out as key skills gaps in the Irish workforce when compared with that of the UK and US. As highlighted previously, Irish FDI business models do not currently focus on bringing the product to market. Rather, its core focus is on manufacturing and R&D which is reflected in the Irish workforce. The dynamic startup base in Ireland, however, is developing new products in addition to managing market access. Therefore, it was highlighted throughout the course of this research that Ireland should build out these commercial capabilities in order to maximise the potential of our start-up ecosystem. Figure 4.2 shows that these commercial and go-to-market skills are primarily learned on the job. There is an opportunity for Connected Health Skillnet to develop industry driven professional training in these areas to upskill the Irish workforce.

Figure 4.2 shows the other key skills gaps that could be supported through on the job training courses include product design and user experience, regulatory know-how and health economic outcomes, specific to digital health products.

Ultimately, the digital health workforce composition in any company, as well as associated skill sets and competencies at any given point in time, depend on the company's overarching digital health strategy (e.g. build, buy or partner) and tend to evolve in line with a company's commercial vision and growth. Across the life science industry (including the medtech and biopharma companies analysed as part of this report), digital health roles currently make up but a small percentage of the total workforce in those organisations. This percentage will likely grow in the coming years, especially as companies embark on a pivot of expanding capabilities to build their own digital health solutions as well as partner with other organisations to gain specialist digital health skills and knowledge.

The analysis of the digital health workforce development pathway revealed that domain knowledge is a key core competency that is generally acquired through education and further developed on the job, as is much of digital health R&D, including software development, hardware development, advanced data analytics and cybersecurity.

Career Case study



Padraig Maguire

Head of Quality & Regulatory Affairs,
S3 Connected Health

Previous roles

- Director, Design Software Verification, Xilinx
- Semiconductor Design Engineer, Silicon & Software Systems

Education

- BE, Electronic Engineering, University of Galway

How did you first hear about careers in digital health?

When I joined S3 Connected Health some years ago, I was introduced to the field of digital health for the first time. S3 Connected Health has been a specialist digital health partner for life science companies for over 20 years, providing regulated solutions for pharma and medtech clients.

What do you like about working in digital health?

Since a young age, I've been intrigued by anything related to medicine. That's why I find the opportunity to merge my engineering expertise with medical technology so appealing. As part of my job at S3 Connected Health, I am responsible for keeping up with the constantly evolving regulatory requirements for digital health. This includes working on projects ranging from companion and condition management solutions for pharmaceutical treatments, to therapy management and device-based solutions in medtech. While this work can be very challenging, I find it incredibly interesting, and it provides me with the opportunity to work on projects that have a positive impact and the potential to transform patient experiences and healthcare outcomes.

Section 5

**Expert insights
into future
digital health
skills needs**

The page features a teal background with a pattern of dark teal dots of varying sizes. A large, light grey circle is centered on the page, containing the main text. To the right of this circle, a smaller light blue circle overlaps with a white circle.

In this section of the report, we synthesise and discuss findings from an international industry survey, three separate roundtable discussions (from the US, UK and Irish perspectives) and 1-on-1 interviews with digital health experts.

5.1 Current and future skills gaps: The international perspective

Current and future digital health skills demands are predicted to change over time in biopharma, medtech and the startup sectors. Results from our international survey predict a high demand for data science and AI, product design and user experience, and specialised regulatory knowledge across all sectors. More specifically, medtech and biopharma will also need to focus on sourcing commercialisation skills.

The international survey was launched to quantify the current and future skills demands in the digital health workforce. This was distributed to biopharma, medtech and digital health executives to understand their needs from the digital health workforce over the next four years. The survey was designed around the digital health skills framework in Figure 3.1. It represents a small segment of the market with 59 respondents.

Demands for regulatory knowledge are currency high across all sectors. In fact, many of the experts interviewed were adamant that irrespective of whether an employee works in a commercial or development function, an understanding of the regulatory landscape is essential to the successful execution of their role.

Skills currently in high demand for digital health R&D vary across sectors

Within the digital health R&D pillar of our Framework, the most in demand skills across all three sectors include product design and user experience, data science and AI. When looking at the breakdown of the results by sector, the top skills gap becomes quite varied,

- with biopharma primarily seeking data science and artificial intelligence skills, followed by product design and user experience, then Information management, risk assessment and cybersecurity.
- medtech respondents' primary skills gap, in addition to data science and AI, relates to information governance & management, risk assessment and cybersecurity.
- digital health startups are experiencing demand for product design and user experience skills followed by software development, programming and coding.

Within domain knowledge, all sectors have a demand for individuals with a clinical, medical and life sciences background. Biopharma and digital health startups are, additionally, seeking to fill digital health roles with behavioural and socio - technical knowledge.

Across the commercial and go-to-market pillar, digital health commercialisation skills are currently in demand across both medtech and biopharma. This result is to be expected as this is unfamiliar territory - neither biopharma nor medtech have standardised how to merge digital offerings with their core products. Go-to-market strategies for digital health in the life sciences industry, while top of mind for many, are not well defined. However, with emerging adoption incentives and reimbursement structures appearing in certain markets, it stands to reason that this category of skills will be in strong demand in the future. (Figure 5.1)

Demands for regulatory knowledge are currently high across all sectors. In fact, many of the experts interviewed were adamant that irrespective of whether an employee works in a commercial or development function, an understanding of the regulatory landscape - and therefore upskilling in this area - is essential to the successful execution of their role. (Figure 5.1)

Interestingly, clinical trial design was highlighted as a key skills gap in 5 out of 6 expert interviews carried out at this stage, yet this did not score highly in the survey. Interviewees were selected specifically for their expertise in digital health with insights into workforce demands. This insight should be considered, given the many questions that befall evidence generation strategies for digital health products. While not emerging as a highly in demand skillset when compared with others, it is important to note that expected future demand for clinical trial design knowledge over the next 4 years did increase across all three sectors surveyed.

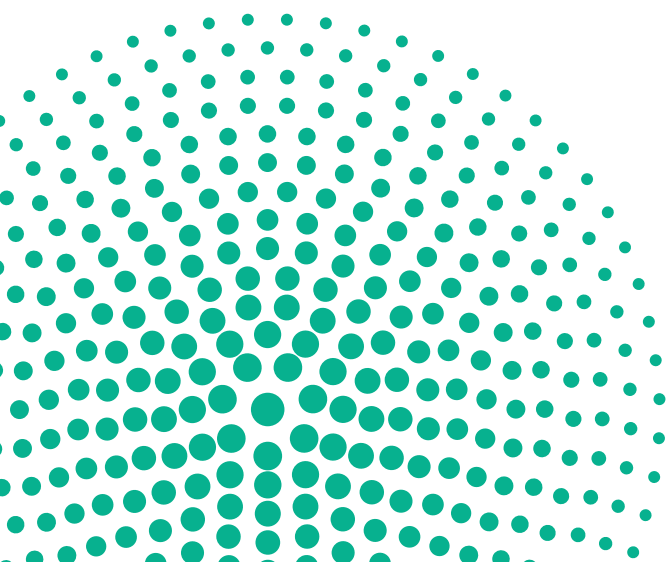


Figure 5.1: Survey results - Current digital health skills gaps according to international industry experts (medtech, biopharma and start ups combined)

Current Demand						
To what extent is each of the following skills currently in demand within your digital health workforce? (5 being highest demand)						
Digital R&D:	N/A	1	2	3	4	5
Product design and user experience	11.70%	3.40%	6.80%	13.60%	27.10%	47.50%
Software development, programming and coding	0%	10.20%	8.50%	23.70%	27.10%	30.50%
Product development (hardware)	10.20%	27.10%	8.50%	22%	25.40%	6.80%
Data science and AI	1.70%	5.10%	5.10%	11.90%	33.9%	42.40%
Information governance & management, risk assessment and cybersecurity	1.70%	10.20%	11.90%	23.70%	20.30%	32.20%
Evidence generation, study design and conduct	3.40%	5.10%	16.90%	25.40%	28.80%	20.30%
Domain Knowledge	N/A	1	2	3	4	5
Clinical, medical or life sciences subject matter expertise, reasoning and application	6.20%	9.00%	17.00%	27.10%	23.70%	17.00%
Health system knowledge	1.70%	8.50%	13.60%	23.70%	28.80%	23.70%
Behavioral and socio-technical knowledge	1.70%	11.90%	11.90%	16.90%	30.50%	27.10%
Commercial and go-to-market:	N/A	1	2	3	4	5
Market research	6.80%	5.10%	18.60%	22%	30.50%	16.90%
Marketing and sales	5.10%	6.80%	10.20%	37.30%	20.30%	20.30%
Commercialisation	5.10%	1.70%	10.20%	22%	27.10%	33.90%
Intra and entrepreneurship skills	6.80%	5.10%	6.80%	18.60%	40.70%	22%
Enablement & Support:	N/A	1	2	3	4	5
Regulation (regulation knowledge)	0%	3.40%	5.10%	18.60%	27.10%	45.80%
Legal and compliance	3.40%	0%	8.50%	22%	33.90%	32.20%
Health economics & outcomes	3.40%	13.60%	11.90%	25.40%	22%	23.70%
Service delivery and implementation skills	0%	7.00%	8.50%	31.60%	29.40%	23.10%
Strategic leadership	1.70%	5.10%	6.80%	15.30%	39%	32.20%

Figure 5.2: Survey results - Future digital health skills demand according to international industry experts (medtech, biopharma and start ups combined)

Future Demand						
To what extent do you anticipate each of the following skills will be in demand within your digital health workforce over the next 4 years? (5 being highest demand)						
Digital R&D:	N/A	1	2	3	4	5
Product design and user experience	0%	0%	8.50%	6.80%	22%	62.70%
Software development, programming and coding	0%	1.70%	15.30%	23.70%	22%	37.30%
Product development (hardware)	8.50%	15.30%	18.60%	27.10%	25.40%	5.10%
Data science and AI	0%	0%	5.10%	13.60%	22%	59.30%
Information governance & management, risk assessment and cybersecurity	0%	5.10%	6.80%	10.20%	33.90%	44.10%
Evidence generation, study design and conduct	1.70%	1.70%	10.20%	20.30%	30.50%	35.60%
Domain Knowledge:	N/A	1	2	3	4	5
Clinical, medical or life sciences subject matter expertise, reasoning and application	1.70%	4.50%	25.40%	28.80%	25.40%	24.30%
Health system knowledge	1.70%	3.40%	6.80%	16.90%	37.30%	33.90%
Behavioral and socio-technical knowledge	1.70%	0%	6.80%	18.60%	30.50%	42.40%
Commercial and go-to-market:	N/A	1	2	3	4	5
Market research	3.40%	3.40%	11.90%	40.70%	20.30%	20.30%
Marketing and sales	3.40%	5.10%	10.20%	30.50%	23.70%	27.10%
Commercialisation	1.70%	1.70%	6.80%	13.60%	33.90%	42.40%
Intra and entrepreneurship skills	1.70%	1.70%	5.10%	30.50%	33.90%	27.10%
Enablement & Support:	N/A	1	2	3	4	5
Regulation (regulation knowledge)	0%	1.70%	3.40%	20.30%	22%	52.50%
Legal and compliance	1.70%	0%	8.50%	27.10%	25.40%	37.30%
Health economics & outcomes	1.70%	5.10%	6.80%	23.70%	20.30%	42.40%
Service delivery and implementation skills	0%	3.40%	5.10%	29.90%	31.10%	30.50%
Strategic leadership	1.70%	0%	3.40%	15.30%	39%	40.70%

Future skills demands closely align with current demands

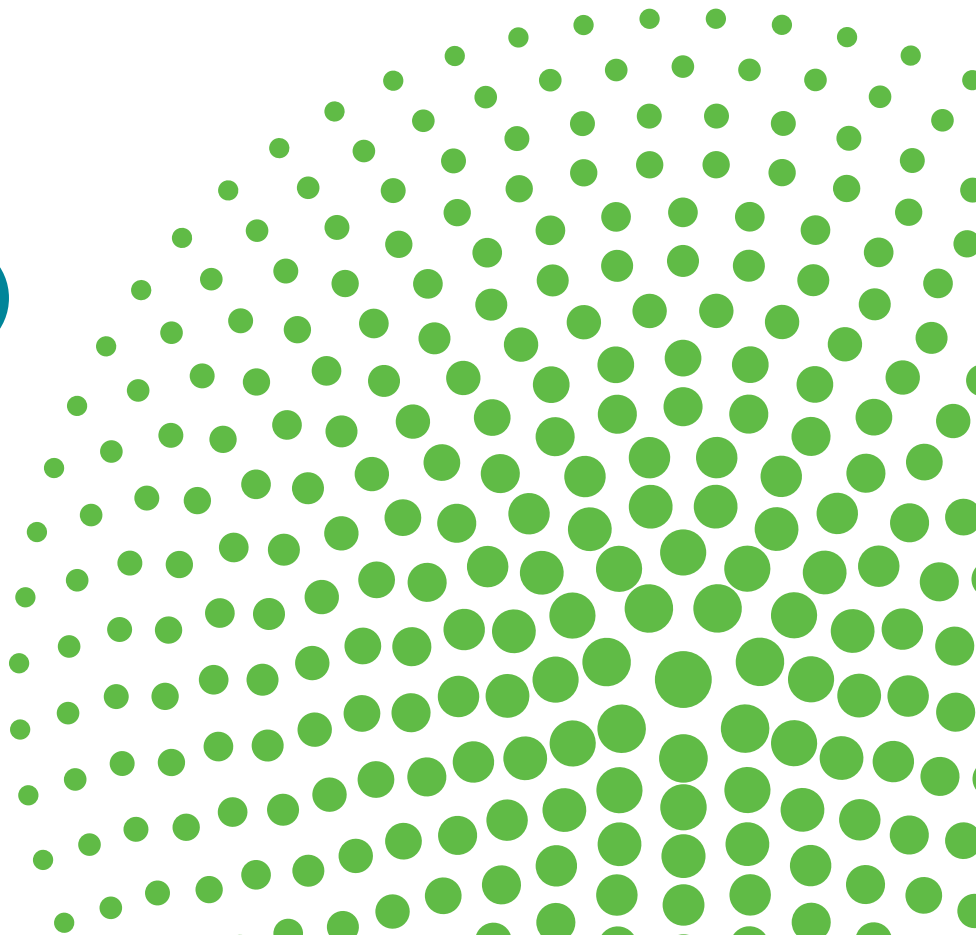
When looking to the future, according to our international survey respondents, the biggest skills demand across all three sectors in the coming years is in product design and user experience, and data science and AI (Figure 5.2). Again, breaking this down by sector shows that in digital health R&D,

- medtech's projected skills demand over the next four years remains focused on information governance & management, risk assessment and cybersecurity followed by product design and user experience research.
- for startups, future demand is projected to increase significantly for data science and AI skills
- in biopharma on the other hand, product design and user experience is expected to emerge as the priority skill need in the next four years. This is a crucial element to success for consumer facing technologies. As digital health begins to grow in pharma and medtech, so will the demand for product design and user experience expertise within digital health R&D.

Beyond this, not surprisingly commercialisation skills and regulatory knowledge are predicted to remain a high demand need for medtech and biopharma, even in four years' time. (Figure 5.2)



When looking to the future, according to our international survey respondents, the biggest skills demand across all three sectors in the coming years is in product design and user experience, data science and AI.



Section 6



High level skills priorities for digital health in Ireland

In this section of the report, we synthesise and discuss findings from a second survey, targeted at leadership of pharma, medtech and digital health companies with Irish-based operations only.

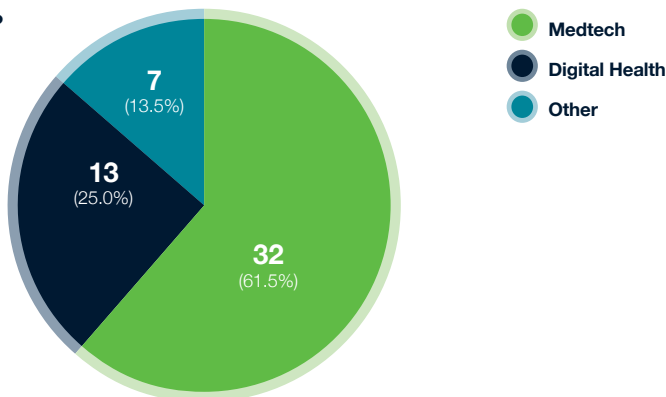
6.1 Digital health: A growing priority for Ireland's life sciences and technology industry

Digital health is a growing priority for the sector, with Irish multinational and startup affiliates pegged as integral in achieving digital health ambitions. Digital health R&D will drive recruitment in digital health, with the development of connected medical devices deemed a core business priority for the sector.

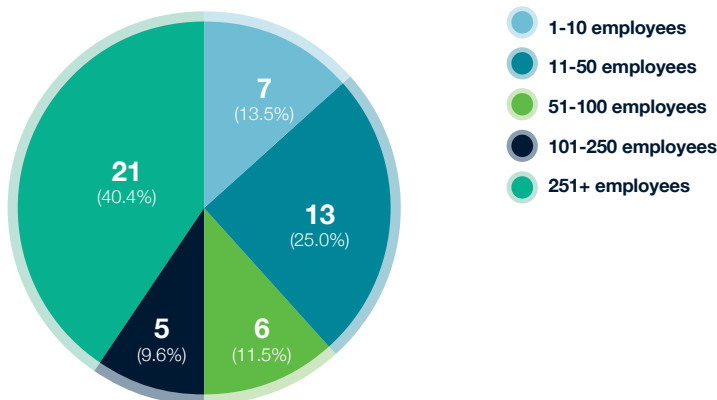
87% of companies said they planned to increase their investment in digital health over the next 4 years, with another 87% saying that their Irish based operations would play a critical role in achieving their digital health ambitions.

Figure 6.1: Irish survey results - Composition of respondents by industry and company size

Q2. Which industry do you work in?



Q4. What is the size of your Irish based operation



The Irish ecosystem survey focused on identifying skills demands over the next four years across both macro and meso categories of digital health skills framework. The survey sought to gain a detailed understanding of the specific skills needed to cultivate the digital health landscape in Ireland at a more granular level.

40% of survey respondents represent large corporations with important Ireland-based operations

This industry survey received a total of 52 responses from 46 unique companies with 62% of responses coming from the medtech industry, 25% coming from digital health, and the remaining responses from the technology and biopharma industries*. 40% of the total set of respondents were from large corporations of 250 employees or more, with the remaining responses coming from a mixture of small and medium sized companies. (Figure 6.1)

Digital health is a growing priority for the sector, with Irish multinational and startup affiliates pegged as integral in achieving digital health ambitions.

When asked about business priorities over the next 4 years, the development of connected medical devices came out as a top priority for many medtech companies, followed by exploring

industry partnerships and developing remote monitoring and diagnostic devices. The digital health industry specified having similar priorities, but also included interoperability with EHR/ wearables etc, and driving adoption as a key focus. In line with overwhelming R&D priorities, the majority (71%) of respondents said that digital health R&D and the digitisation of their product portfolio would indeed be ‘very important’ to their company in the next 4 years. (Figure 6.2)

87% of companies said they planned to increase their investment in digital health over the next 4 years, with another 87% saying that their Irish based operations would play a critical role in achieving their digital health ambitions. To deliver on their digital health priorities, 35% of respondents intend to have ‘All’ of their functions based in Ireland, followed by manufacturing (27%), commercial (14%) and regulatory (12%) functions. (Figure 7.3)

Jobs forecast: Digital health R&D is a key driver for new hires in digital health

Survey respondents estimated that across the different macro skills categories, they would hire a total of 1,909 individuals over the next four years. More than 50% of all anticipated hires will be for the digital health R&D skills category thus suggesting a clear strategic focus for the sector as a whole. (Figure 6.4)

* For the purpose of this survey, we combined technology and biopharma responses and designated those as ‘other’. While the survey was equally circulated across all three industries, a much lower proportion of biopharma companies took part. Subsequently, it was decided to focus the analysis on the medtech and digital health sectors.

Figure 6.2: Irish survey results - 4 year priority of Digital health R&D in Ireland

Digital R&D priority

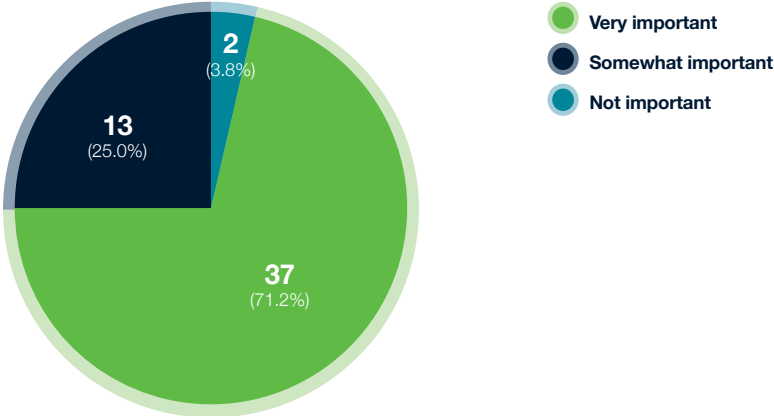


Figure 6.3: Irish survey results - Role of Irish-based operations in achieving company digital health ambitions

Will your Irish-based operation play a role in achieving your organisation's digital health priority/ambition/activity?

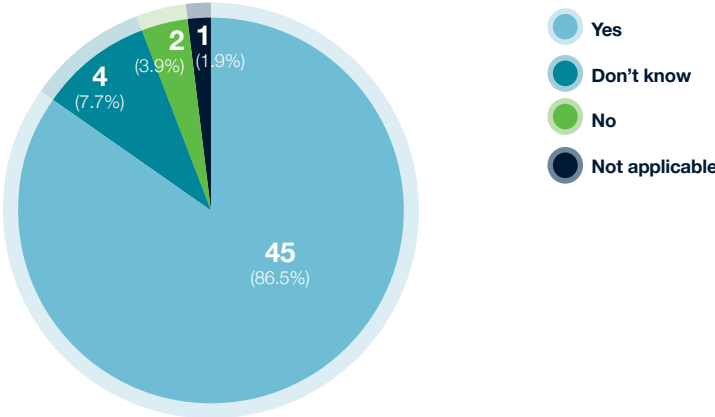
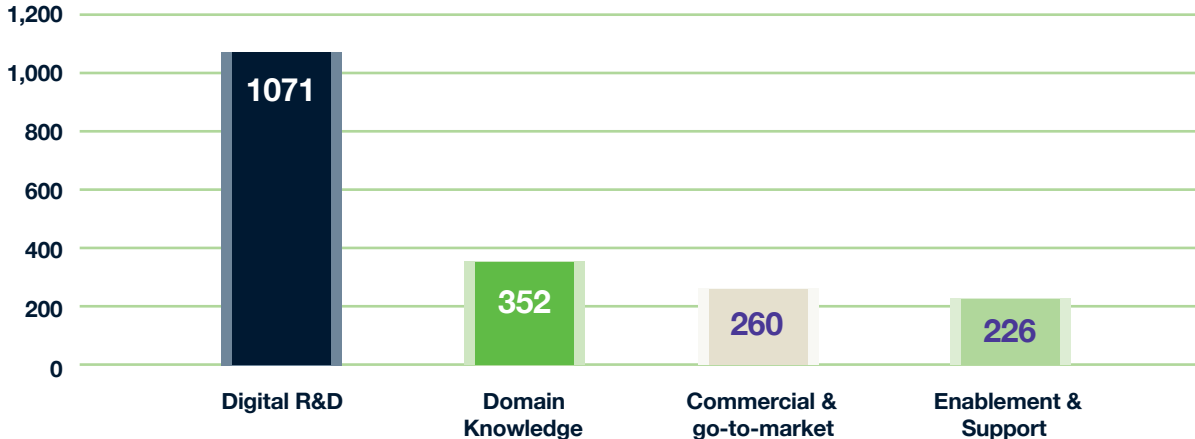


Figure 6.4: Irish survey results - Anticipated number of hires in the Irish digital health workforce over the next 4 years, categorised by stage in the value chain

Number of hires



6.2 Skills priorities for the digital health sector in Ireland

Product design and user experience, software development, programming and coding as well as data science and artificial intelligence are predicted to be the most in-demand skills for the sector over the next four years. Training and education programmes for the digital health sector in Ireland should support the development of industry specific in-demand skills as a matter of priority.

Future skills demand for the digital sector are centred on digital health R&D

The survey demonstrates a direct correlation between the digital health sector’s focus on digital health R&D and the skill areas that will experience the greatest demand over the next

four years. **The five highest ranked macro skills overall are found within the digital health R&D skills category.** These are the skills the sector will need to actively hire for or seek to build internally.

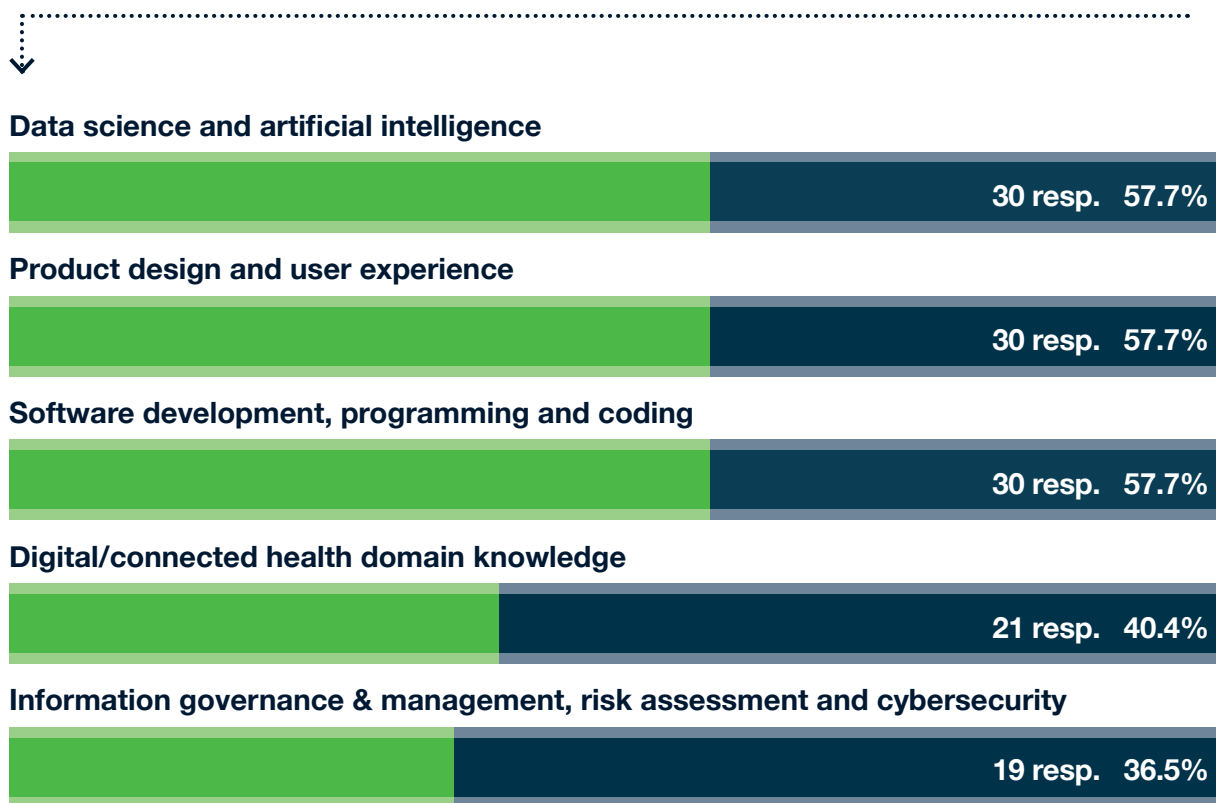
Data science and artificial intelligence, product design and user experience, as well as software development, programming and coding ranked in joint first place with 58% of the votes each. Further high demand is anticipated for digital/connected health domain knowledge and information governance and management, risk assessment and cybersecurity. (Figure 6.5)

When asked about current skills gaps, it transpired that software engineering in the healthcare industry is experiencing an acute shortage in the Irish market at present. This shortage is likely further exacerbated by the high level of competition for this talent across other (non-healthcare sectors) coupled with the high cost of talent.

Figure 6.5: Irish survey results - Top 5 skills areas for which the Irish industry intends to hire in the next four year

What are the top 5 digital health skills areas that you will need to build/hire for in Ireland over the next four years?

52 out of 52 people answered this question (with multiple choice)



The Skillnet Ireland model has a proven track record of supporting organisations to upskill individuals who already possess transferable skills to benefit from new career opportunities. Given that in 2020 Ireland had the highest level of ICT graduates as a share of third level graduates in the EU, there is an excellent talent base in Ireland from which to build these digital health specific skillsets.

Digital health domain knowledge (for product owners), data scientists and regulatory expertise were also mentioned as key skills gaps currently experienced by the sector.

Top 3 digital health R&D skills gaps will be filled with new hires

The survey revealed differences for how in demand skill priorities would be met. The top three meso skill gaps - data science and artificial intelligence, product design and user experience as well as software development, programming and coding - would be met through new hires predominantly. (Figure 6.6) Digital/connected health domain knowledge, on the other hand, respondents suggested would be built in house. Information governance & management, risk

assessment and cybersecurity will be outsourced for many respondents, while others are opting to build these skills in house. Respondents were less agreed on how they will fill demand for product development (hardware) skills, with participants considering hiring, outsourcing and in-house skill building in near equal measure.

Prioritising skills: the sector has identified a core set of essential meso skills across the value chains

The Irish ecosystem survey sought to understand specific skill demands over the next four years under each macro and meso skill category. The most in-demand meso skills, that is the most essential skills for each macro category, are listed in Figure 6.7. The skill demands are further broken down by sector.

The ranking of meso skills in Figure 6.7 paints a clear picture of skills in highest demand across the various stages of the industry value chain in Ireland, according to our survey results. The results represent responses from both the medtech and digital health industry. Pharma industry participation in the survey was low and, as such, have been excluded.

Figure 6.6: Irish survey results - Preference for hiring or partnerships building to meet top 5 macro skill demands

Hire vs Partner

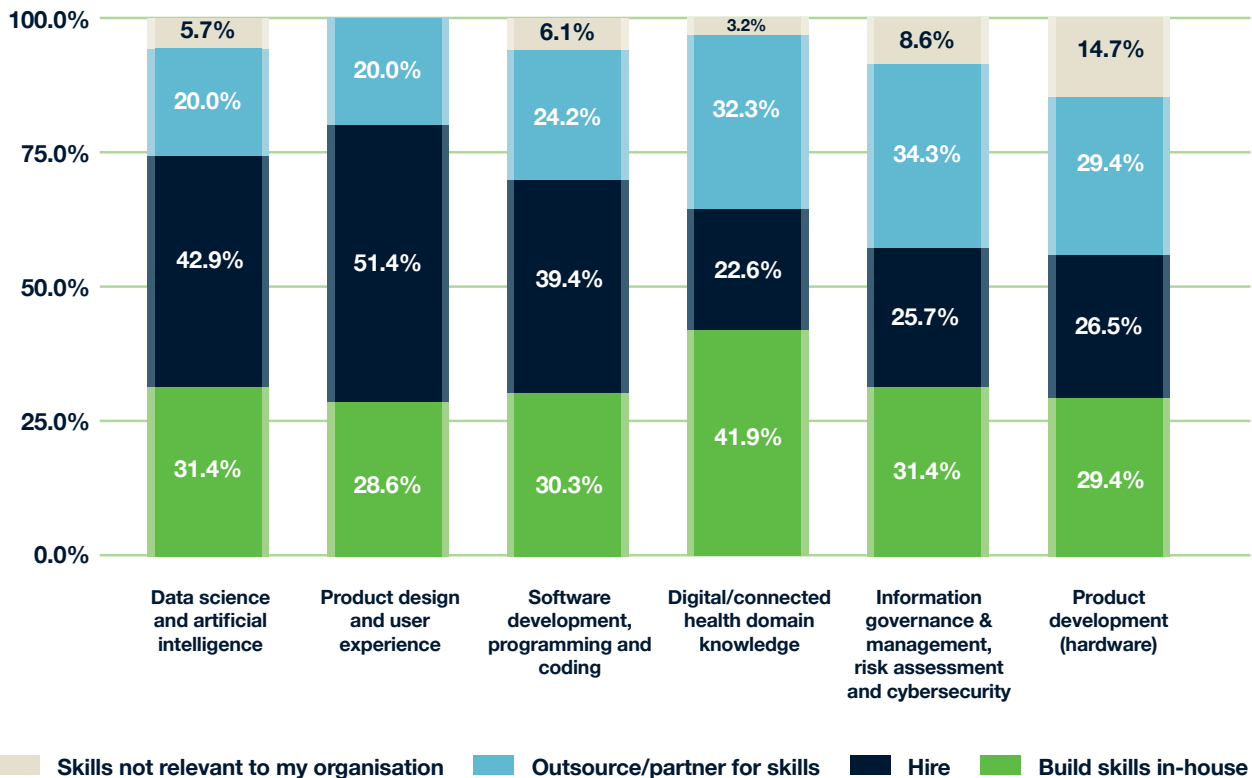
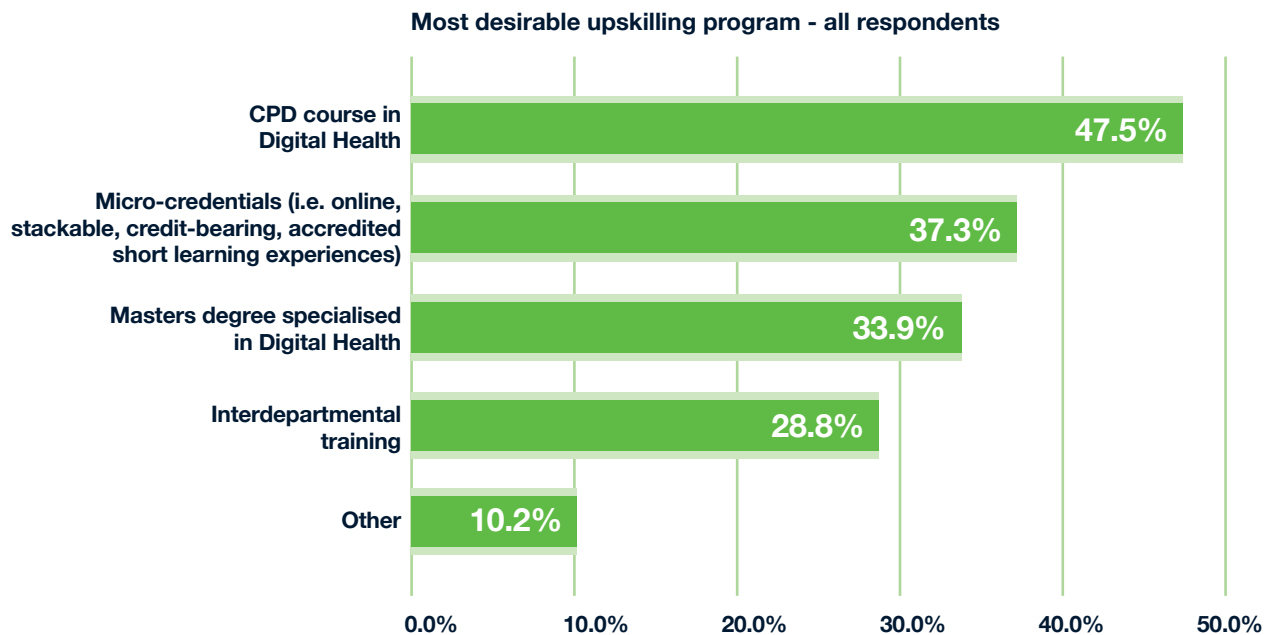


Figure 6.7: Irish survey - Breakdown of skills in highest demand across the digital health skills framework

Medtech			
		Digital Health	
Digital Health R&D	Digital Health R&D leadership	<ul style="list-style-type: none"> - Strategy design (e.g. product market fir/fail/success, go/no go - Partnership building 	<ul style="list-style-type: none"> - Strategy design (e.g. product market fir/fail/success, go/no go - Partnership building
	Product design and user experience	<ul style="list-style-type: none"> - Designing for clinical and commercial outcomes - Design research (eg UX/UI research) 	<ul style="list-style-type: none"> - Product management - UX/UI design
	Software development, programming and coding	<ul style="list-style-type: none"> - Medical device software regulation - Digital health software architecture 	<ul style="list-style-type: none"> - Software as a medical device (SaMD) development - Digital health software architecture
	Data science and artificial intelligence	<ul style="list-style-type: none"> - Systems of systems - Healthcare artificial intelligence (AI) 	<ul style="list-style-type: none"> - Healthcare artificial intelligence (AI) - Healthcare machine learning (ML) & deep learning
	Product development (hardware)	<ul style="list-style-type: none"> - RF Communications (Bluetooth, WiFi, LoRa) - Medical device regulation 	<ul style="list-style-type: none"> - Medical device regulation - Embedded system development (hardware)
	Information, governance & management, risk assessment and cybersecurity	<ul style="list-style-type: none"> - Cloud Security (AWS/Azure/Google Cloud) - Date governances and date (protection) compliance 	<ul style="list-style-type: none"> - Cybersecurity engineering - Cloud Security (AWS/Azure/Google Cloud)
	Evidence generation, study design and conduct	<ul style="list-style-type: none"> - Data monitoring and reporting - Patient safety and ethics 	<ul style="list-style-type: none"> - Patient safety and ethics - Data monitoring and reporting
Domain knowledge	Domain knowledge	<ul style="list-style-type: none"> - Medical and therapeutic area knowledge) - Health systems knowledge 	<ul style="list-style-type: none"> - Digital health knowledge (at various levels of expertise) - Identifying value-enhancing use cases for digital health
Commercial and go-to market	Commercial and go-to market	<ul style="list-style-type: none"> - Identifying unmet user needs - Digital health commercial strategy design 	<ul style="list-style-type: none"> - Identifying unmet user needs - Digital health commercial strategy design
Enablement & Support	Regulatory Knowledge	<ul style="list-style-type: none"> - ISO/IEC standards - Knowledge of and navigation of key regulatory frameworks 	<ul style="list-style-type: none"> - Knowledge of and navigation of key regulatory frameworks - Data governance and data (protection) compliance
	Enablement & Support	<ul style="list-style-type: none"> - Partnership building (strategic leadership) - Change Management 	<ul style="list-style-type: none"> - Securing stakeholder buy-in (strategic leadership) - Data privacy and compliance expertise

Figure 6.8: International survey results for most desirable upskilling program (n = 52)

Combined with the earlier finding that digital health R&D is a core driver of digital health activity, the following macro skills categories and associated meso skills transpire as most essential to the success of this sector over the next four years: **Product design and user experience, software development, programming and coding as well as data science and artificial intelligence.**

Specific meso skill requirements differ based on industry. For instance, within product design and user experience, the design of clinical and commercial outcomes is highest in demand for the medtech industry, while effective product management is most coveted by the digital health respondents. Within software development programming and coding, medical device software regulation presents the biggest anticipated skills gap for medtech, while SaMD development will be the most sought after skills within digital health companies. Within data science and artificial intelligence, systems of systems is the most desired skill within the medtech industry, while healthcare AI is a critical hiring area for digital health companies.

This insight will enable Connected Health Skillnet to focus all new programme development and training networks programme funding received through Skillnet Ireland towards targeted skills area that will have the greatest impact for the sector in Ireland. These focus areas will be aligned to the four pillars of our digital health skills framework and include AI for healthtech, SaMD, regulation and leadership development. The Network will also continue to deliver cross sectoral networking and knowledge sharing events to support the development of a common digital health language and collaboration across industries.

Section 6.3 Preferred methods for upskilling a digital health workforce

In addition to identifying the skills which will be highest in demand for the digital health workforce over the next four years, our research, in the form of the Irish and international surveys, three expert roundtables and a series of 1-on-1 interviews explored what potential upskilling programmes could look like.

Industry executives and startup entrepreneurs indicate a preference for CPD courses as the most desirable vehicle to upskill for digital health roles.

Almost all survey respondents (84%) from the international survey were of the opinion that some form of formal training in digital health would be valuable in prospective candidates. With the vast majority selecting CPD courses as the most desirable program type (Figure 6.8). A separate analysis of Irish respondents only confirmed that within the local context, CPD was also the favoured approach to upskilling the digital health workforce, with e-learning or accredited part-time courses being the preferred method of training (Figure 6.9).

In terms of educational backgrounds, it would appear that across biopharma, medtech and digital health, medical and life sciences degrees were seen as the most valuable educational backgrounds, followed by computer science (Figure 6.10).

Figure 6.9: Irish survey results for preferred method of training delivery (n = 52)

What is the preferred method of training when upskilling/reskilling your workforce?

52 out of 52 people answered this question (with multiple choice)



eLearning



Accredited part time courses



Short unaccredited courses



Mirco-credential modules



Other

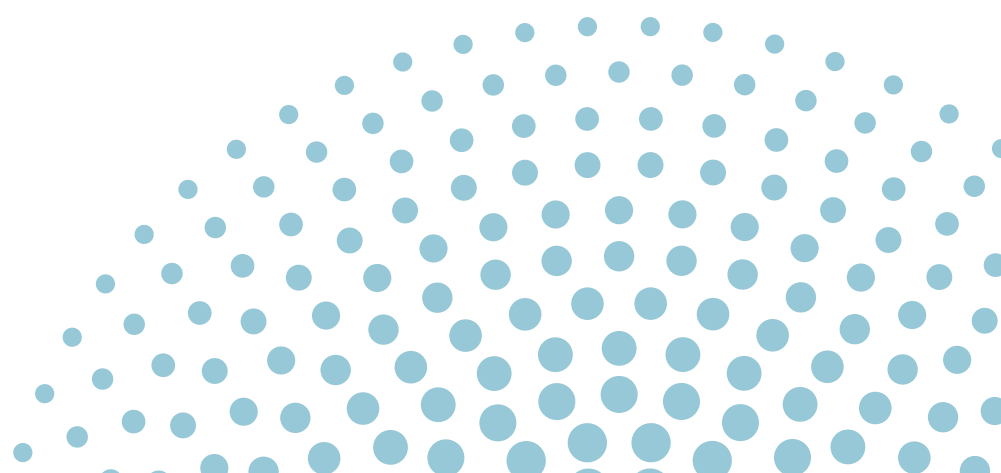
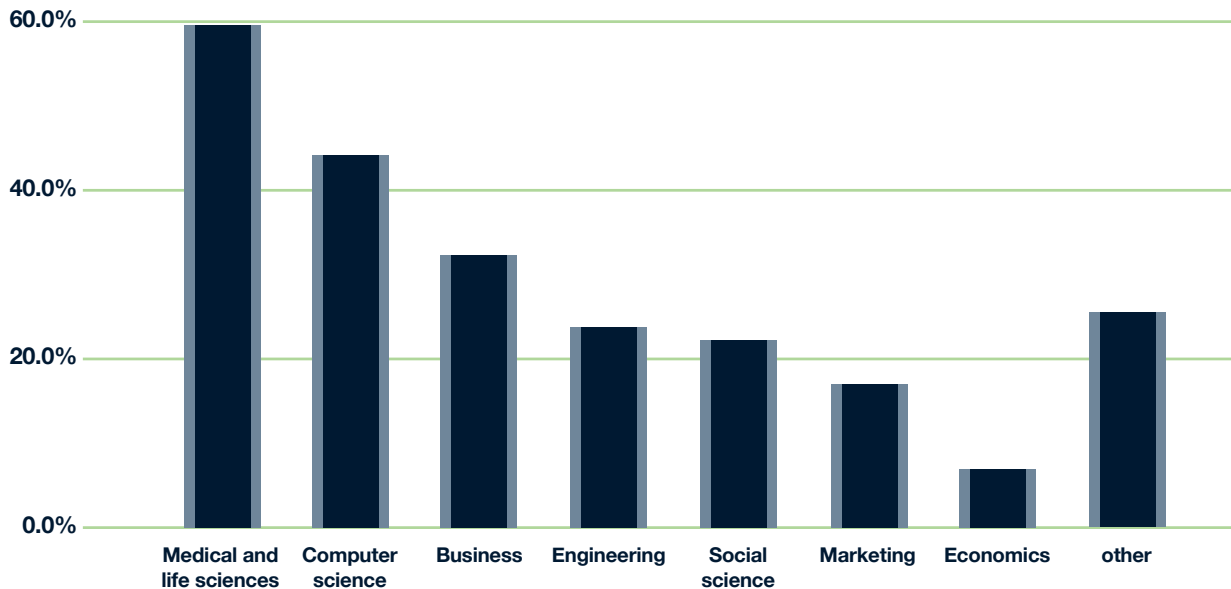


Figure 6.10: International survey results for most valuable educational background (n = 59)**Most valuable background - all respondents**

6.4 Expert Insights on Upskilling Digital Health Workforces

Rather than building lengthy degrees specific to digital health, an opportunity exists to include digital health modules in the core curriculum of STEM programmes. This would have the advantage of signposting a potential career path at the undergraduate level. Focused digital health undergraduate and postgraduate courses will not plug current skill gaps

Experts from our UK, US and Irish industry roundtables suggested that specific undergraduate and postgraduate training in digital health is not required or desired by hiring managers. While this may speak to the nascency of digital health, and perhaps should be reconsidered once the landscape is more developed, it was unanimously disregarded as a core vehicle to prepare the Irish workforce over the next 5-10 years. In fact, it was pointed out that as digital health is in a rapid growth phase, any level 8, 9 or 10 curriculum would quickly become dated and irrelevant and so would not be a valuable use of resources. Experts felt that Continuing Professional Development (CPD) was, in fact, the sufficient level of formal training when hiring for digital health roles.

There is an opportunity for Connected Health Skillnet to develop new enterprise led training initiatives in the short term where learning outcomes are directly linked to the sectors needs and identified skills gaps across the four pillars of the digital health skills framework (Figure 3.1).

STEM is a basic requirement for most digital/health roles

Referring more specifically to the skills framework, experts agreed that a demonstrated literacy within STEM was an important basic requirement for most digital health roles, and thus an undergraduate degree in these areas is a common baseline requirement when hiring for graduate digital health roles in Ireland. Rather than building lengthy degrees specific to digital health, experts suggested that digital health modules could be weaved into the core curriculum for STEM university programmes, where relevant. The emerging STEM workforce would subsequently be equipped with the awareness and knowledge of the types of careers available within digital health, enabling them to carve out a potential 'career path' at the earliest. Examples of modules that could be included in these core courses are listed below):

- Practical modules about how computational chemistry and machine learning is leveraged to advance drug discovery within the life sciences curriculum
- Applications of data sciences in life sciences
- An introduction to digital therapeutics within the behavioural sciences
- A specific healthcare lens as part of cybersecurity courses
- An introduction to digital health module in undergraduate/postgraduate medicine courses

Learning on the job

Experts conceded that an unfortunate truism of the digital health sector is that it is currently the preserve of senior industry executives (likely due to the ‘newness’ of the discipline and the fact that digital health is not yet a recognised educational discipline). Access to tailored digital health training programmes developed by industry, for industry, will support organisations to upskill and reskill existing talent to take up digital health roles. Connected Health Skillnet, funded by Skillnet Ireland, is an important partner in delivering these industry driven training interventions. The Network already delivers grant funded training in key areas such as Software as a Medical Device, regulations and leadership development, and will align future new programme development activity to the four pillars of the digital health skills framework.

In order to nurture digital health talent at its earliest, industry internships, placements and/or apprenticeship models for recent graduates should also be pursued as a way ‘to learn on the job’, as this is likely going to be crucial at training the next generation of the digital health workforce.

Investing in the development of one single area will not put Ireland on the map as a hub for digital health talent and innovation. Rather its about building teams consisting of employees with complementary skills who, importantly, can all speak the same language.

Dealing with the pace of digital health: key soft skills will need to be nurtured

Moving beyond formal digital health training, softer skills such as flexibility and innovation were highlighted as highly desirable in potential digital health candidates, given that the space is so fast paced. It was mentioned that PhD graduates across STEM acquire these skills through their research, but may need help in applying them to other subject areas. PhD graduates who have also demonstrated intra- or entrepreneurial skills (through innovation showcases, personal endeavours etc) were regarded to have a broadly applicable mindset for flexibility and innovation. Additional examples of soft skills were given from digital health startups, such as leadership, project management, along with entrepreneurship, where high value is placed on versatile, adaptable employees and quick learners.

In Ireland: Specialists are preferred over generalists

Perhaps one of the most contradictory topics discussed across the three roundtables was the idea of hiring a digital health generalist vs a team of specialists. US and the UK experts, operating heavily in the commercialisation and implementation of digital health, professed a preference for hiring ‘digital health unicorns’ across the various sectors. The preference for generalists was perhaps most pronounced in the startup space, where they are accustomed to designing everything from scratch and have to create roles that have not existed before, get to grips with new regulatory pathways, and quickly learn how to navigate new data legislation. One startup gave the example of hiring six roles bridging the clinical, medical and commercial realms. Employees joining startup organisations often have a steep learning curve ahead of them and they have to become experts in an area quickly. The digital health space is constantly evolving, and prior knowledge tends to become outdated quite fast.

“We put a lot of value into somebody who is commercial but can jump into an enablement role, somebody who is clinical but can jump into a commercial role. There is a different way of slicing [skills] and that is about culture and work ethics – that’s our biggest skills gap.” (Key insight from the UK expert roundtable)

Business leaders from the Irish roundtable, however, advised that given the strength of manufacturing operations in the country, many organisations are focused on recruiting specialists. More specifically, it was agreed by the Irish experts that as this space is so nascent, the competencies of digital health experts or unicorns have yet to be defined. Rather, hiring a complimentary team of employees with a suite of competencies is the key to success. This team should collaborate to solve the challenges at hand, be they in R&D, product development or commercialisation. As such, investing in the development of one single area will not put Ireland on the map as a hub for digital health talent and innovation. Rather its about building teams consisting of employees with complementary skills who, importantly, can all speak the same language.

Career Case study



Michael Kelly

Software Engineering Manager, FIRE1

Previous roles

- Senior Embedded Software Engineering, Software Engineering & Electronics Engineering

Education:

- B.Eng Electronic Engineering

How did you first hear about careers in digital health?

When I joined a medtech startup, I was initially drawn to the exciting healthcare solutions and technologies that the company was developing. As I became more involved in the industry, I began to notice the growing trend of emerging technologies such as mobile apps, wearables, and telemedicine that were disrupting traditional medical device markets. Through research and word of mouth, I discovered digital health as a sector within the broader healthcare technology sector.

What do you like about working in digital health?

When working in digital health, the “why” is always easy. When the product you are developing helps patients and health care workers, it’s easy to justify the time and effort you spend every day working on the product.

There is great variety to the challenges that you will encounter. Not only the technology, but also understanding the needs of users and understanding the healthcare domain that you are working in. For example, heart failure patients within cardiology.

There are lots of opportunities to innovate and have impact across many healthcare disciplines. Digital technology is becoming an integral part of people’s everyday lives. With an aging population and healthcare staff shortages, the demand for digital health solutions is only expected to increase, and the recent advancements in AI offer exciting possibilities for the field.

Section 7

Recommendations to develop a world leading digital health workforce in Ireland

The Irish medtech industry is globally recognised as a centre for excellence. Similarly, Ireland is a flourishing manufacturing hub for the biopharmaceutical industry and a headquarters to many digital health companies. Internationally renowned as a testbed for innovation, Ireland boasts a thriving digital health startup ecosystem.

Over the next four years, digital health R&D - connected product development and digitalization of product portfolios - will emerge as a key priority for the digital health sector in Ireland. This skills needs analysis reveals that over the next four years, the following skills will be in particularly high demand: Product design and user experience, software development, programming and coding as well as data science and artificial intelligence.

In order to maintain its reputation as a world-class manufacturing and R&D hub, the digital health sector must invest in upskilling its workforce to meet the demands of an increasingly complex healthcare landscape. Key recommendation from this work include:

Data from the Irish ecosystem suggests that beyond priority R&D skills, the sector would most likely experience a high demand for digital/connected health domain knowledge. The prerequisites to work within digital health R&D are extremely technical and often do not necessarily require prior (digital) healthcare-related work experience.

1. Double down on essential R&D competencies

Digital health R&D will experience the greatest skill demand across the digital health sector. Clear digital health R&D priorities have been identified throughout this research and initiatives to further skills development should be encouraged. Ireland has a strong digital health R&D workforce already, boasting, for instance, a higher concentration of essential skills in software development, advanced data analytics, information management and cybersecurity.

Doubling down on essential R&D competencies will require a two-pronged approach, one that requires continued promotion for STEM education, while also identifying opportunities for rapid upskilling and re-skilling of existing workforces through Government led initiative such as Skillnet Ireland.

2. Prepare for external markets

While the focal point for digital health in the traditional life sciences industries in Ireland is centred around strategy and R&D, the digital health companies have broader aims: they are not only focused on strategy and product development, but also commercialisation and adoption. While digital health R&D, is certainly a key priority for the sector, many digital health companies rely on commercialising their products and services in external markets rather than the Irish market. Upskilling digital health companies in their understanding of the regulatory and reimbursement environments abroad will prepare them for product launch and commercialisation in key digital health markets, allowing companies to maximise value extraction from their world class R&D efforts.

3. Further digital health domain knowledge and establish a common language among R&D specialists

Data from the Irish ecosystem suggests that beyond priority R&D skills, the sector would most likely experience a high demand for digital/connected health domain knowledge. The prerequisites to work within digital health R&D are extremely technical and often do not necessarily require prior (digital) healthcare-related work experience. While extreme specialism (across the value chain) might be a preferred approach in the life sciences industry, experts consulted for this report suggested that a generalist expertise would allow digital health teams to avail of a common language to effectively communicate with one another. For instance, it was suggested that software developers would benefit from upskilling in regulation, while product owners would be more effective in their roles if they acquire better insights into clinical and health systems dynamics.

The skills framework developed for this research report provides the scaffolding for Connected Health Skillnet to develop generalist digital health upskilling programmes which would certainly benefit smaller digital health companies, where flexibility and role adaptability are commonly required.

4. Define a career path for STEM graduates

The key step in making Ireland a prime hub of digital health talent would be to extend the boundaries of excellence in core R&D competencies. Producing high volumes of quality STEM graduates will build the foundation upon which digital health talent and literacy can be moulded. Efforts must be made to attract coveted STEM graduates to the healthcare industry. High salaries and attractive benefits provided to STEM graduates by large technology companies leave behind a very sparse pool from which the healthcare industry can hire. Digital health must compete with big tech in Ireland should it want to attract the best talent.

Therefore, providing university students with an introduction to and/or specialised modules in digital health at the earliest will not only prime students to consider a career in digital health at a much earlier stage in their education journey, but will also ensure that graduates are already equipped with digital health domain knowledge by the time they enter the workforce. Furthermore, higher participation of life sciences and digital health companies in graduate internship programmes would further attract STEM graduates to a career in digital health.

5. Deliver on demand upskilling

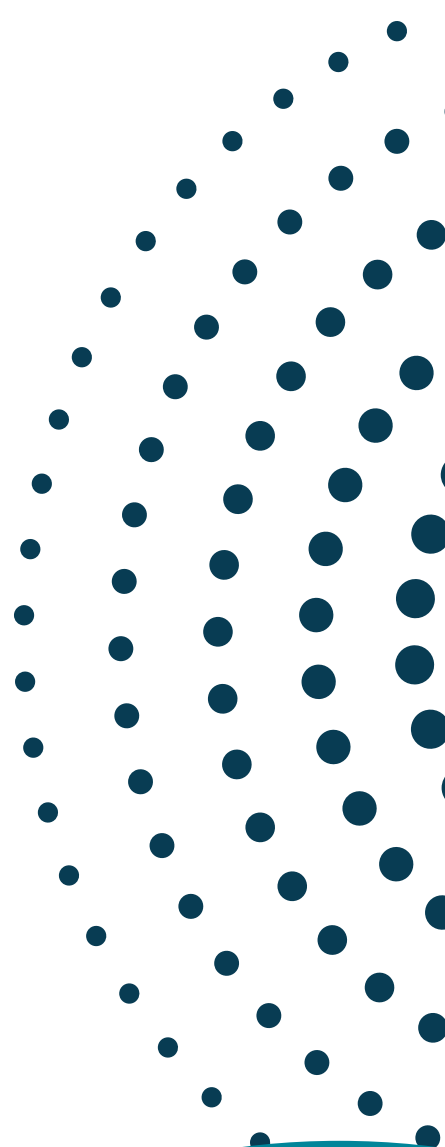
Providing on-demand upskilling opportunities for the current life sciences and technology industries in the area of digital health will ensure that, where possible, urgent skills gaps are continuously minimised. Digital health is a fast moving space, and this must be borne in mind when designing upskilling programmes for professionals in the sector. As such, certain digital health functions would benefit from regular and rapid upskilling in particularly fast evolving areas such as regulation and reimbursement.

6. Enable partnerships in the short term

For many companies in the digital health sector, talent acquisition strategies are determined by strategic imperatives of the company at a particular point in time. The current phase of digital health is certainly focused on partnerships as a key vehicle to expand capabilities in this new market. Ireland has a thriving digital health ecosystem, yet small Irish companies are often overlooked as prospective partners. There is an opportunity to support and incentivise partnership formation across the local ecosystem.

7. Establish and support a community of best practice


Peer-to-peer learning is a key knowledge sharing practice within the international digital health community. Given the nascency of the sector, stakeholders are keen to learn from those who have had early successes. There is an opportunity to stand up and support a local digital health community of practice in Ireland focused on knowledge transfer and showcasing best practices from within the Irish ecosystem.



Section 8

**Ireland, a
location of
choice for
digital health**





This section provides an overview of the digital health ecosystem in Ireland.

8.1 Ireland, a location of choice

Ireland is a leading location for business with an international reputation for attracting foreign direct investment thanks to business-friendly policies that have helped grow the economies depth and breadth while serving global markets. One of the country's most notable success stories is the life sciences industries with the world's top companies investing heavily here and creating jobs alongside homegrown businesses driving disruptive innovation. The life sciences sectors have evolved from a world class manufacturing base to a leader in R&D creating life transforming products and solutions, with companies located right around the country.

There are now an estimated 700 companies in biopharma, medtech and digital health industries operating in Ireland. These businesses collectively employ more than 90,000 people directly. Moreover, as major engines of economic growth the life science sectors have exports of an estimated €120 billion and played a notable role during the global pandemic in leading the charge to help people (Irish Medtech Association, Ibec 2023).

The biopharma industry has evolved across regional clusters over Europe to meet the demands of science-based innovation that relies on knowledge sharing. Ireland is one of the leading global hubs for the development, manufacturing and supply of medicines and their ingredients. Ireland remains the location of choice for new and cutting edge biopharmachem molecules.

The biopharma industry represents the evolution from traditional pharmaceuticals, based on chemical production, to now incorporating biotechnology with a growing focus from traditional drugs to new trends. These emerging trends include: Cell and gene therapies, Personalised medicine, and Pharma 5.0.

The medical technology industry is an important component of the larger healthcare system notably in the areas of preventing, diagnosing, and treating illness.

The hub is over 100 years in the making and over time it has developed a proven track record for next level product development, our resilient supply chains, our connections to strategic markets.

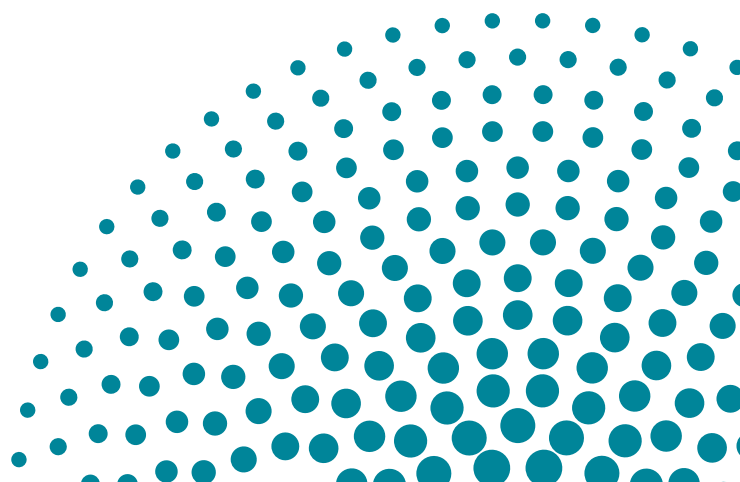
Globally, the medtech sector is defined by its strong history of research and innovation with the average medtech worldwide R&I investment rate estimated to be approximately 8% in the sector. In addition, continued indigenous investment in R&D will ensure Ireland is positioned to develop and equipped to deliver with the latest thinking and skills, while operational excellence, advanced manufacturing technologies and innovation will ensure market competitiveness. The industry is changing in response to the latest trends, including: 3D printing, medical robotics, as well as homecare and telemedicine.

Digital health is set to drastically transform both the medtech and biopharma industries across the globe. It was highlighted that the digital health sector has very specific skills demands to take product from the ideation and R&D stages right through to commercialisation. If Ireland is to maintain its status of excellence within the pharma and medtech sectors, it needs to sufficiently invest in the development of its workforce and cultivate talent beyond traditional R&D and manufacturing to remain a competitive player within these industries.

8.2 The Digital health ecosystem in Ireland

Several ongoing initiatives seek to raise awareness and investment for Ireland as a Digital Health Hub. Ibec launched "Where Digital Health Thrives" in collaboration with BioPharmaChem Ireland, Technology Ireland and Connected Health Skillnet in 2020. According to their research, as of November 2020 Ireland had nearly 200 digital health companies in its ecosystem, spanning the areas of connected medical devices, remote patient monitoring, telehealth, data, analytics and cyber security, health information technology to name a few.

The aim of this campaign is to raise understanding of the potential of digital health in Ireland and facilitate its growth into a global hub for digital health⁷. A key pillar to support this is talent development through the Connected Health Skillnet - one of many Government-funded upskilling and reskilling initiatives aimed at supporting industry talent development.



Numerous innovation hubs are emerging in the country, tasked with the pursuit of furthering the digital health status of the country. Some of these initiatives are outlined in Box 8.1.

Box 8.1: Irish digital health innovation hubs

1. Health Innovation Hub

HHH is a national network of innovation hubs in Cork, Dublin, and Galway that was established by the Department of Business, Enterprise and Innovation and the Department of Health in 2016. It is supported by Enterprise Ireland and the Health Service Executive (HSE) to drive collaboration between the health service and enterprise to develop new innovative solutions.

2. Digital Health Validator Programme

Validator is a two month digital health incubator established to enable early stage digital health startups to validate their business idea and find product-market fit in the European market. It is co-hosted at Trinity College Dublin, the University of Dublin in collaboration with EIT Health.

3. ICT for Health at Tyndall National Institute:

Tyndall's ICT for Health is a research ecosystem comprising academic partners, global leaders in medTech and pharma as well as clinical experts to deliver novel solutions in several areas including diagnostics, connected health and smart drug delivery systems.

4. dConnect:

dConnect is a digital health cluster supporting startups, helping to commercialise research. dConnect supports early-stage companies with access to education and access to a network for growth while supporting larger businesses with access to leading-edge innovation. dconnect was established to stimulate, foster and enhance innovation in Digital Health. The goal is to create enterprises, products and services addressing the healthcare needs of society.

5. HSE initiatives:

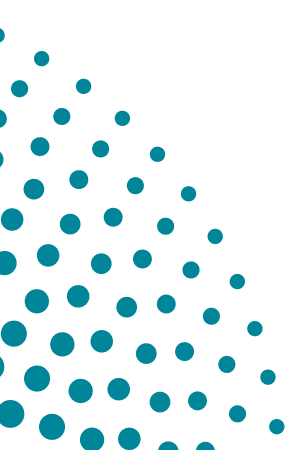
The HSE recently partnered with the UK's Department for International Trade to help promote digital innovation in Ireland. This will allow the HSE to tap into the UK's burgeoning digital health sector, to help with Ireland's ambition to be a Digital Health leader in Europe by 2025¹⁹.

6. Guinness Enterprise Centre:

The GEC is a leading entrepreneurial superhub that provides office space, advice, national and international reach and a community for startups and scaling.

7. Connected Health and Wellbeing Cluster:

The Enterprise Ireland-funded Cluster at Dundalk Institute of Technology (DkIT) will encourage and facilitate increased collaboration between industry (indigenous and FDI), academia and government to increase collaboration, innovation and internationalisation of cluster members.



Ireland's Digital Health Ecosystem

For the purposes of this map we have partitioned the ecosystem into nine specific categories, identifying key areas of how Digital Health addresses global challenges. These categories broadly reflect solution types to offer a consistent view of digital health activity in Ireland.

We classify companies within the ecosystem as follows:

- **Connected Medical Devices**
e.g. Wearable & Wireless Medical Devices; Software driven diagnostic products; Therapy delivery devices; Biometric Sensors
- **Digital Therapeutics**
Software driven therapeutics

- **Mobile Health (mHealth) & Wellness**

e.g. Wellness, fitness trackers, nutrition & lifestyle apps; Virtual health assistants; Healthcare Coaching

- **Personalised Healthcare**

e.g. Precision Medicine; Personalised support, symptom management and interventions; Clinical decision support solutions

- **Remote Patient Monitoring & Telehealth**

Remote patient monitoring solutions; Medication adherence tools; Telemedicine virtual visits and remote care programmes

- **Health Information Technology (HIT)**

e.g. Electronic Medical Record systems; Electronic Prescribing and order entry systems; Consumer health IT applications

- **Connected Care Management**

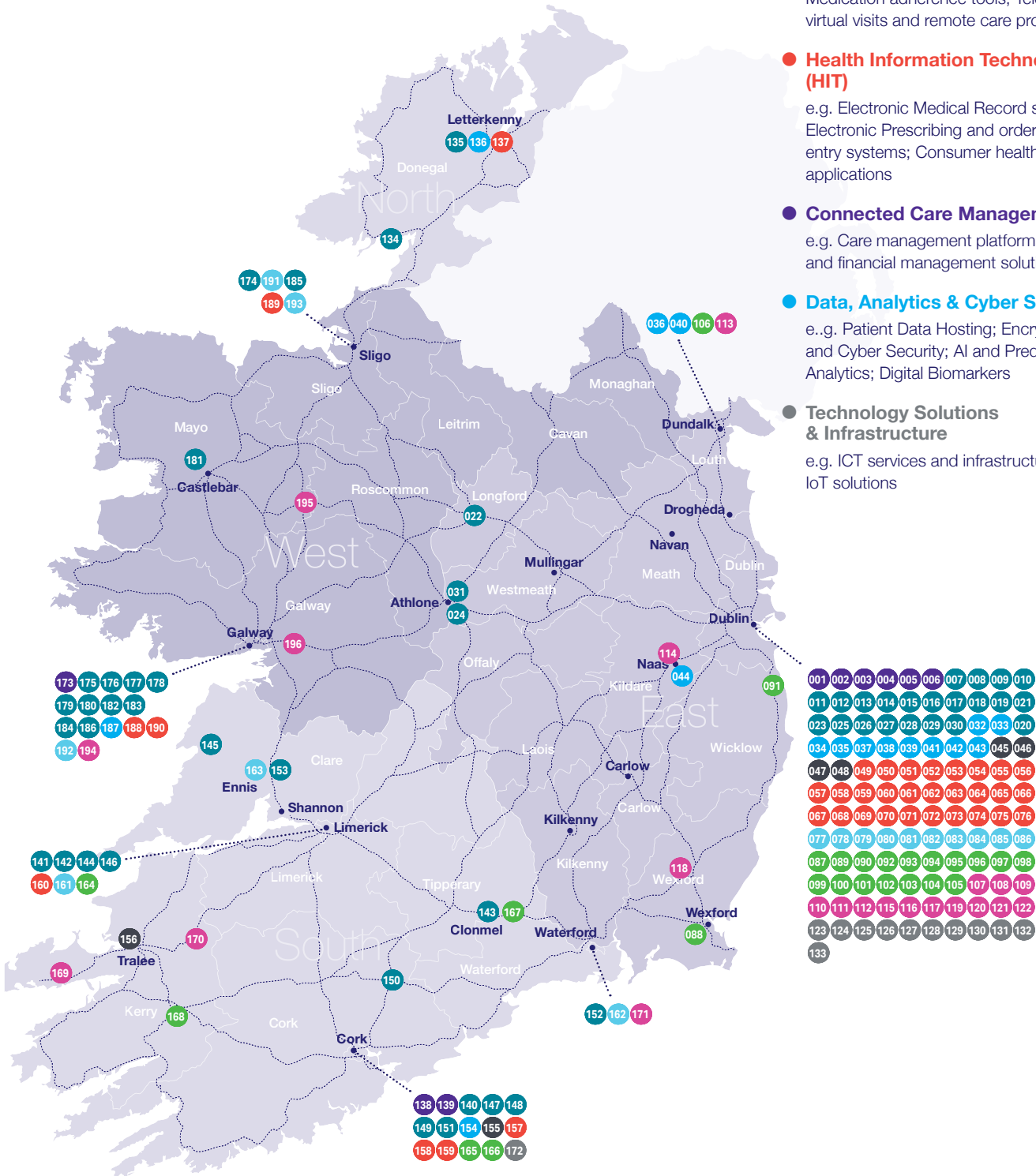
e.g. Care management platforms, staffing, and financial management solutions

- **Data, Analytics & Cyber Security**

e.g. Patient Data Hosting; Encryption and Cyber Security; AI and Predictive Analytics; Digital Biomarkers

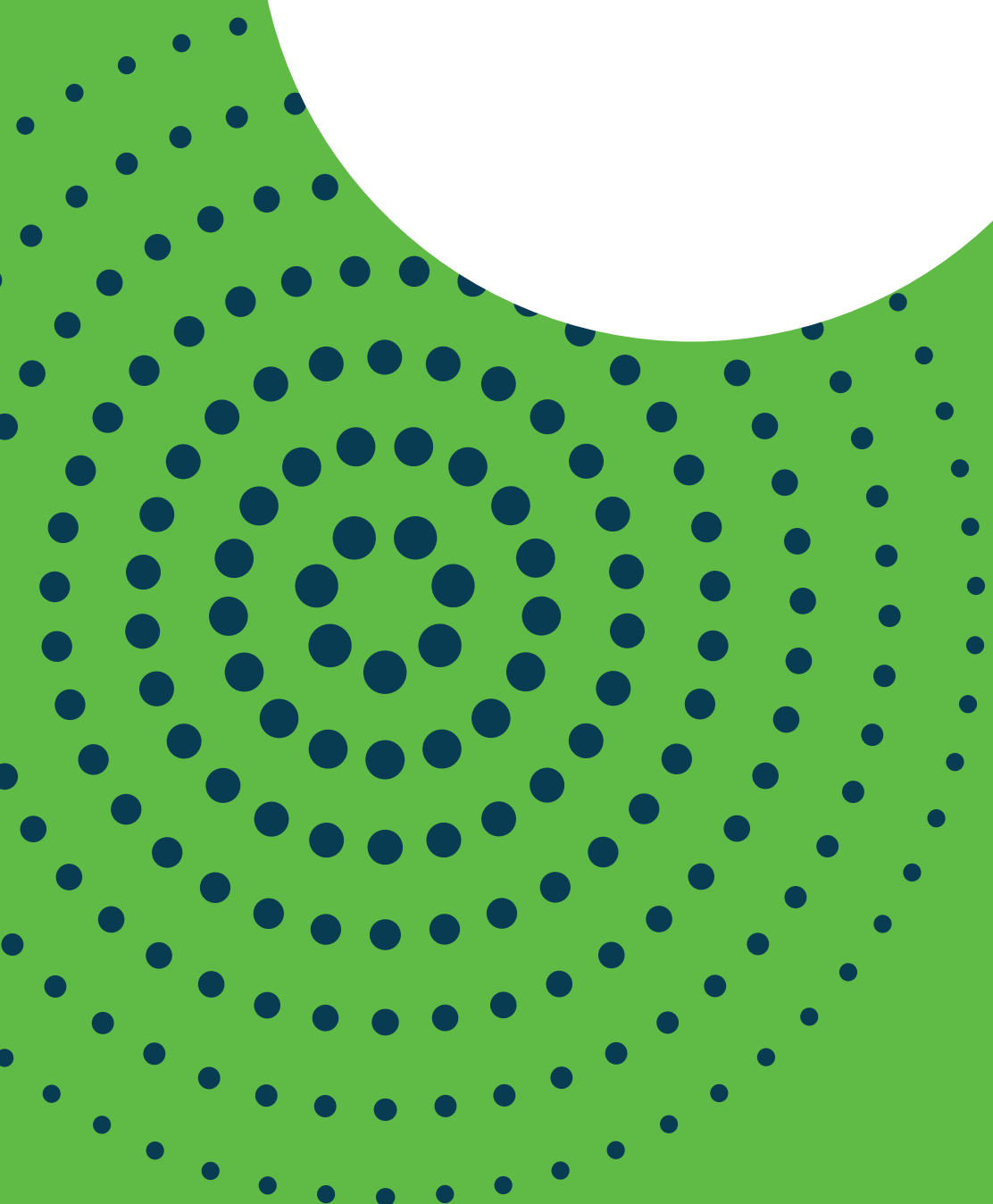
- **Technology Solutions & Infrastructure**

e.g. ICT services and infrastructure; IoT solutions



Section 9

Conclusion



This section concludes the research and introduces select considerations for how to meet future skills demands.

9.1 Ireland: A potential digital health R&D powerhouse

The Irish ecosystem survey demonstrates that life sciences and technology companies in Ireland see digital health a key growth area in the coming years. In order to support these companies in expanding their digital health footprint in Ireland, it is vital that they can tap into an education and training infrastructure that caters to their skills needs. The skills needs analysis presented in this report signposts the most essential areas with digital health that will likely benefit from tailored (up)skilling programmes.

This report highlights digital health R&D as the key growth sector for digital health in Ireland over the next four years, given the heavy manufacturing focus of the life sciences and technology industries in the country. As such, efforts must be made to attract coveted STEM graduates to the healthcare industry.

Data science, product design and software development, and cybersecurity came out as the top skills demand areas within digital health R&D. Within each of these broader macro skills categories we have identified meso skills that we will need to nurture to ensure that Irish-based multinationals and digital health companies attract digital health projects. Connected Health Skillnet will work with its Industry Steering Committee over the coming years to ensure that upskilling and reskilling activities are fully aligned to the needs of the sector in Ireland.

Digital health domain knowledge also emerged as a key development area for the life science and technology industries. Digital health is nascent to the Irish landscape: in order to develop a competitive industry, it will be important to build teams with complementary or cross-cutting skillsets who, importantly, will be able to speak the language of all functions. Regulation is a prime example of a cross-cutting skill that, while a specialism in its own right, could be imparted cross-functionally.

The research also highlighted that as Ireland is a manufacturing powerhouse of the life sciences/technology industries, with its products being exported and commercialised abroad, there is a lack of digital health specific commercialisation skills within the Irish workforce. Ireland should consider developing stronger capabilities for product commercialisation in order to maximise value extraction from their world class R&D efforts. This will be particularly relevant for the Irish start-up ecosystem.

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Appendices

Digital Health Skills Sectoral Analysis

Pharma

MedTech

Startup

Incubator/Accelerator

Digital Health Skills Sectoral Analysis – Methodology

Identify Relevant DH Roles

For each of the selected companies, LinkedIn Sales Navigator (SN) was used to identify relevant digital health roles.

Sort DH Roles by Geography

For each of the organisations listed we use SN to locate individuals based on geography (Ireland, UK, US).

Identify Individual DH Job Roles

Individual job roles are predominantly found by narrowing the criteria to include only those with specific search terms in the individual's title. Search by an individual's title identifies relevant roles solely within the individual's current 'Role' or 'Title'.

Supplementary Keyword Search*

Keyword searches are used to find individuals due to differences across organisations (e.g. DH titles/teams). This may refer to previous roles and these individuals require further examination before addition to the dataset.

Supplementary HXL Platform Search

Additional individuals and relevant digital health roles were identified using HealthXL's own internal member database and internal knowledge of company structures.

Profile Addition to Database

Individuals are checked for relevance by HealthXL to assess the job title, role and experience on LinkedIn. All relevant individuals are added to a dataset.

*Keyword and title search examples include: 'digital health', 'digital innovation', 'digital strategy', 'digital endpoints', 'digital biomarkers', 'digital medicine', 'digital therapeutics', 'DTx', 'digital lab', 'digital hub', 'connected health', 'organisation specific search terms.

Connected Health Skillnet

The Connected Health Skillnet is an enterprise-led, learning and development network established to address the current and future skills needs arising from the convergence of the medtech, biopharma, ICT and software sectors in the dynamic field of digital health,

Together with our Promoting Organisation promoting organisation, Irish Medtech Association, our focus is to enhance the capability of Ireland and Irish based companies to become recognised global leaders in the development and commercialisation of Digital Health solutions. We support this through the delivery of niche training, upskilling and important cross- sectoral networking opportunities to help facilitate collaboration and innovation between sectors.

The network addresses both technical and non-technical skills needs and since 2018, has engaged with over 200 companies from across the medtech, tech and pharma sectors to upskill 1000+ trainees in key areas including medical device software, quality and regulatory, cybersecurity and leadership development.

www.connectedhealthskillnet.ie

BioPharmaChem Ireland

BioPharmaChem Ireland represents the biopharma and chemical sectors. We influence, support and represent the sector in realising its ambition by bringing together all relevant stakeholders in the State, namely: industry, the government, the research community and the public at large to effectively communicate the unique attractiveness of Ireland as a leading location for the supply and development of pharmaceutical products.

Irish Medtech Association

The Irish Medtech Association is the business association within Ibec representing the medical technology, invitro diagnostic, and digital health sectors. The Irish Medtech Association has more than 350 members, located throughout the island of Ireland.

Led by a Board of CEOs and Chief Representatives, it implements its strategy through working groups and taskforces. In 2022, the group launched its new strategy, The Global Medtech Hib 2025 - Dedicated to the expected, the unexpected and everything in between, which puts innovation, talent, and excellence through collaboration at its heart, underscored by competitiveness.

As a supporter of collaboration, we uphold our responsibility to promote ethical business practices to ensure that engagement between industry and healthcare professionals is conducted in a transparent manner to deliver innovation that improves patient lives.

The Irish Medtech Association is the promoting organisation for the Connected Health Skillnet. The objective of this national network is to enhance Ireland's position as a global digital health hub by developing a strong talent base and enhancing the specialised knowledge and skills that exist within the sector and allied sectors.

Skillnet Ireland

Skillnet Ireland is the national Talent Development Agency of the Government of Ireland, responsible for advancing the competitiveness, productivity, and innovation of businesses through talent and workforce development. Skillnet Ireland focuses on the upskilling challenges businesses face including climate action, digital transformation, innovation and leadership. Skillnet Ireland supports businesses through enterprise-led learning clusters, with 70 Skillnet Business Networks and national upskilling initiatives across a wide range of sectors and regions in Ireland.

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An Roinn Breiseideachais agus Ardoideachais,
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