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Northern Ireland
Science Industry Panel

Life & Health Sciences Northern Ireland

April 2024

Foresight study to assess how the City and Growth Deals can provide opportunities for Northern Ireland's Life and Health Sciences Sector

From Potential to Progress

Embracing a collaborative and synchronised approach between industry, government, Health and Social Care and academic institutions is essential for Northern Ireland's (NI) Life and Health Science (LHS) sector to flourish. In particular, the deployment of the City and Growth Deals (CGDs) sets the stage for progress, providing the conditions for collaboration and innovation to thrive.

Consequently, Matrix, the NI Science Industry Panel, supported by the Health Innovation Research Alliance - Northern Ireland (HIRANI) in conjunction with the Department for the Economy, has developed this foresight report which outlines the necessary measures to stimulate the structured development of the LHS sector within the context of the CGD investments.

This foresight report is the product of research and consultation with a wide array of stakeholders across the LHS sector in NI and from outside NI. These include representatives from industry, industry associations, universities, the health organisations, translational centres and government. The recommendations herein intend to harness and integrate the strengths of NI LHS sector's innovative and commercial capabilities around the CGDs, with the aim of developing a leading LHS hub in Europe.

Co-chairs of Matrix Life and Health Sciences Panel

Joann Rhodes

Richard Kennedy

Vision

Supercharged by capital investment in the form of CGDs – NI can become home to a coordinated LHS ecosystem, one focused on specific capabilities to power intellectual property (IP) creation, deliver a skilled workforce, and position our LHS sector to prosper in the global market.

Our Ambition

Powerful articulation of niche LHS strengths in NI

Collaboration across stakeholders

Support structure set up for success, with ability to amplify NI's story

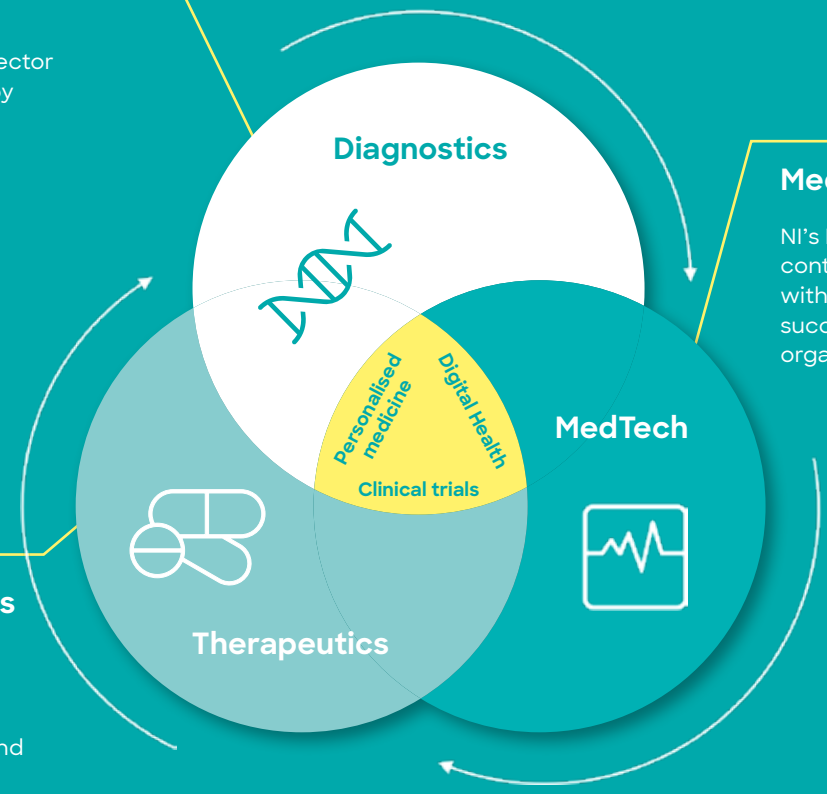
Global recognition of a leading destination to do world-class business

NI's Strengths in LHS

NI's Interlocking LHS ecosystem

Diagnostics

NI's diagnostic sector is underpinned by indigenous firms recognised on a global scale.



MedTech

NI's MedTech sector continues to grow, with increasing success of spin-out organisations.

Therapeutics

NI's aspirational goal is to grow and develop the biotechnology and pharmaceutical sector, increasing its global position as a full LHS ecosystem.

Ecosystem supported by deliberate investments in centres of excellence

Economic output of LHS in NI:

The LHS sector accounts for >25% of NI's economy output, generating a Gross Value Add (GVA) in the region of ~£1.2billion. With >170 LHS firms located in NI, the sector employs an estimated 19,500 individuals.[1,2]

Priority Actions

What	How
Drive cohesive growth in NI's LHS sector.	By establishing a multidisciplinary advisory panel to develop a unified LHS strategy, aligning CoE developments with regional and global goals, and providing strategic oversight to CGDs and their respective councils.
Enhance industry engagement and international outreach.	By having the panel define a unified vision, while driving co-ordinated cross-sector collaboration to achieve initiatives and helping define clear engagement pathways with the CoEs, facilitating technology transfer, attracting foreign direct investment, and leveraging funding opportunities from various sources.
Provide LHS leadership through pragmatic resource allocation.	By appointing a chairperson with the necessary experience and influence. The advisory panel should aim to build on existing industry-facing sector-specific implementation forums.

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01 Executive Summary

Executive summary

NI's LHS Industry

Growing vitality of the NI LHS sector

The significance of NI's LHS sector should be celebrated within the context of the United Kingdom's (UK) government identifying it as a priority sector and its recognition as a contributor to NI's economic vision. With over 170 enterprises and nearly 100,000 individuals actively engaged in NI, the sector demonstrates remarkable vitality. It is developing niche specialisations in areas such as Personalised Medicine and Digital Health, MedTech and Clinical Trials.

Opportunities to achieve true potential

The potential of the sector can be enabled by seizing key opportunities. These include defining a unified vision, articulating a defined value proposition concerning niche strengths, and further driving cross-sector collaboration.

> "NI already punches above its weight in LHS within the UK, and fresh capital injections could catapult our status to global relevance.
>
> *Pharmaceutical sector consultee*

The City and Growth Deals

Advancing the sector through City and Growth Deals

NI has a unique opportunity to shape the development of the LHS sector through the CGDs. These deals, developed under the UK Government's Levelling Up agenda, deliver capital only investment of over £1.5bn and are entrusted to local councils for the development of sectoral strengths, with the aim of driving knowledge collection, collaboration, and skills growth.

~25% of the CGDs funding for NI is oriented towards further developing the LHS sector. The capital expenditure is focused on the development of various CoEs, which are expected to drive progress.

The Centres of Excellence

The CGDs are separated into four regions across NI, with LHS CoEs being established across each region, with further full details of the CoEs to be published. The £1bn Belfast Region City Deal (BRCD) is being directed towards developing centres for digital health care innovation, clinical trial acceleration, data analytics, agrifood, and advanced manufacturing.

Propelled by £260m of CGD funding, investment in the UU School of Medicine and Personalised Medicine Centre will further enhance LHS capabilities in the Derry City and Strabane region.

In the Mid South West Region (MSWR), £250m of CGD funding is primarily expected to help realise the region's potential in manufacturing and agrifood, with additional specific investments in an obesity centre and initiatives in health innovation being planned.

The Causeway Coast and Glens CGD will receive £72m in capital funding, with six key themes identified to assist the local economy. This CGD will establish multiple CoEs, with the Centre for Food and Drug Discovery (CFDD) linked to UU as an example.

Ecosystem stakeholder perspectives towards the deals

60% of stakeholders in NI are aware of the City and Growth deals, which is a good starting place as the Centres are yet to engage in prolonged outreach.[1] Some of the CoEs have similar or adjacent areas of expertise, raising interest among stakeholders about the need for a unified vision and strategy across both the deals and the sector more generally. Stakeholders hope for a clear narrative for NI's LHS sector, as well as a clearer understanding of how these deals could accelerate the execution of its vision.

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[a] All figures presented in this section are grounded in Matrix' baseline analysis of the sector, unless otherwise stated.
[b] Survey results provided by thirty NI LHS and government members between April to May 2023; survey distributed by Department of Economy NI.

Responsibility for progressing the CGDs

The LHS sector in NI has a promising future for growth and development, which is being catalysed by the CGDs. Under the devolved decision-making aspects of the Levelling Up agenda, these CGDs are being progressed by local councils. There are opportunities to coordinate activities across CGDs and their respective local councils in a cohesive manner and to present them with the option to tap into a broader pool of external LHS expertise to ensure success.

Lessons from International LHS hubs

Establish a path towards sustainable growth

Analysing global LHS hubs underscores NI's capacity to bolster sector growth using multiple strategies. A successful blueprint from international hubs suggests the journey begins with kick-starting the ecosystem's public funds to catalyse initial growth, then smoothly transitioning into private sector support for enduring sustainability. Consultations with ecosystem stakeholders for this report suggested greater opportunity and benefits to NI as funding comes available for the LHS sector.

The examination of international hubs also revealed that another lever for NI's LHS sector could be to integrate skills from adjacent industries, such as manufacturing and cybersecurity. The cross-industry innovation that would likely arise could provide NI with a unique value proposition.

It is also pivotal for NI to not only draw initial investments from multinational corporations (MNCs) but to foster an environment that beckons recurrent commitments, as shown by pharmaceutical giants like Novartis and Johnson & Johnson in dedicated regions. Consequently, consultees expressed a desire for a focused LHS Foreign Direct Investment (FDI) approach.

To ensure a prosperous future, NI needs to reflect on these learnings, and shape an environment conducive to both domestic expansion and global investment.

Recommended Action

Recognising the opportunity that presents itself for NI to build on its strengths and emulate other successful LHS hubs, we propose that the local councils progressing the LHS CGDs would benefit greatly from coordination and stronger alignment with NI strengths and ambitions in the sector.

We propose that a third-party panel, representing diverse specialties across LHS and guided by an agreed-upon finalised overall strategic vision for NI, coordinate the activities across the CGDs with the local councils, while providing independent expert advice.

The local councils will naturally remain the leading parties for the CGDs, but with the aim of giving them the support they need to unify their LHS efforts and drive cohesive growth of the sector. This approach will also allow for a focused LHS FDI strategy, while utilising expertise and sector insights into the NI ecosystem to drive efforts and LHS development.

Analysis of Northern Ireland's LHS Sector

NI's LHS sector exhibits a range of strengths, weaknesses, opportunities, and threats that reflect its current state and future prospects. These elements are briefly highlighted here and are explored on coming pages.

Strengths

- Specialised LHS niches
- Unique post-European Union (EU) exit operating environment
- Impactful academic institutions
- Presence of globally recognised companies, with NI demonstrating a strong business track record
- LHS ecosystem support by HIRANI

Opportunities

- CGD capital investment
- Alignment of niches with global macrotrends
- Increased utilisation of well characterised patient cohorts for clinical trial excellence (iREACH)
- Growth of adjacent sectors in NI with relevance to LHS (e.g. cybersecurity, software engineering, others)
- Growth potential of the overall sector, while increasing academic and industry collaboration
- Coordinated CGD councils, working with a singular LHS expert panel for implementation of the CGDs

Weaknesses

- Relatively smaller LHS ecosystem compared to other UK regions
- Balancing indigenous growth with attracting FDI
- Limited capacity in the existing support organisation for the sector (HIRANI)
- Lack of awareness and access to LHS investment funds in NI
- Limited numbers of clinician scientists

Threats

- Competition for global voice from other UK and Ireland LHS hubs
- Competition beyond UK & Ireland from global LHS hubs
- Investment and talent could flow to other sectors in NI with clearer value propositions
- Lack of resources available to the health service to meaningfully engage in innovation across the LHS ecosystem

02

Northern Ireland's Cluster Overview

NI's LHS industry today

The LHS sector in NI shows remarkable vitality, with over 170 enterprises spanning segments as diverse as Agri-health through to Digital Health Software contributing to the overall sector.

A rising force in LHS

Growing vitality of the NI LHS sector

The LHS sector in NI boasts more than 170 LHS enterprises and demonstrates significant vitality, as evidenced in this report. This vitality is expressed through the growing number of organisations and employees contributing to this sector and innovative scientific research that is translating into practical, real-world solutions. The LHS sector in NI employs an estimated 19,500 individuals, while an estimated 72,000 individuals work in the wider health and social care system. [2] [3]

Indigenous powerhouses leading the way

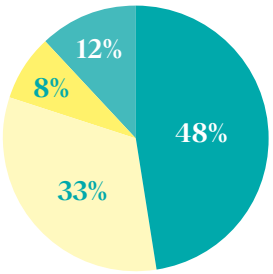
The community is characterised by indigenous Northern Irish firms that have grown organically and employ thousands of skilled individuals. Notable businesses include Almac, Randox, Cirdan and Diaceutics who have demonstrated their agility and scalability, particularly during the Covid-19 pandemic. It also includes multinational companies such as Stryker, Terumo and Teva Pharmaceuticals which have operations in NI, as well as a range of other ambitious, innovative start-ups and spin-outs such as Axial3D, pHion Therapeutics, Cumulus Neuroscience and BeSecur.

While there are multiple examples of successful indigenous growth, the region can further develop key characteristics of successful innovation hubs, such as a seed investment fund, collusion spaces, official innovation mentorship programs, regulatory and business development supports and a structured framework for innovation within the health system. These building blocks are needed as NI seeks to realise its vision of moving from relative anonymity to becoming a global player on the LHS stage.

Diversity across sub-sectors

Our analysis of the sector reveals that approximately 48% of the organisations are in the MedTech & Diagnostics field (broadly segmented into those operating in Digital Health (24%), Core Medical Devices (14%), and In-vitro Diagnostics (IVD) (10%)). Approximately 33% belong to the broader LHS domain (including contract clinical trial organisations (CRO) (5%), contract manufacturing organisations (CMO) 1%, packaging (3%) and supply chain management (24%). Approximately 8% are in the therapeutics industry (including biotechnology (2%) and pharmaceuticals (6%) and, while the remaining businesses operate in smaller segments of the ecosystem (12%), such as Agri-health or consultancy LHS. The sector also benefits from adjacent industries of strength in NI such as manufacturing, software and digital technology. An opportunity is presented to integrate NI's strengths across these sub-sectors to capture future opportunities and maximise benefits from the CGD initiatives.

Approximate relative size of LHS segments in NI based on number of organisations focusing in each category.



- MedTech & Diagnostics (e.g. Devices, Diagnostics, Digital Health Software, etc.)
- Life Science Services (e.g. CRO, CMO, Packaging, Logistics, etc.)
- Therapeutics
- Other (e.g. Agrihealth, Consultancy, etc.)

[a] Diversity across sub sectors has been rounded to the closest whole number
[b] Market segmentation based on 178 organisations identified operating in NI across the LHS industry. Pie chart rounded in closet whole number.

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A priority industry sector for future growth

The UK Government has identified LHS as a priority industry sector

UK's Strategic Vision for LHS

The LHS sector is a crucial component of the UK's strategic economic framework. Recognising its paramount importance, the UK government has committed to growing the sector and ensuring its place as a pivotal area for the nation's future economic prosperity. This commitment is manifested in the launch of the 'UK's Life Science Vision' which was published by the Department for Business, Energy & Industrial Strategy in 2021.

The vision underscores the following key objectives:

- Firstly, to leverage the UK's capabilities in Clinical Research, Genomics, and Health Data, aiming to establish the country as an optimal hub for testing and trialling cutting-edge technologies that address significant healthcare challenges.
- Secondly, to establish the UK as the premier global destination for discovering, developing, testing, trialling, launching, and adopting novel treatments and technologies. This objective includes fostering a progressive commercial environment where the National Health Service (NHS) can secure flagship agreements and rapidly adopt proven, clinically and cost-effective innovations.
- Thirdly, to position the UK as the most appealing location in Europe for initiating and expanding a LHS company in terms of ease of doing business.

In alignment with these objectives, the UK government has made a robust commitment, in terms of both substantial financial and infrastructural support, to foster growth in the LHS sector.

NI's Further Prioritisation of the LHS sector

In addition to being identified as a priority industry for the UK, LHS also features prominently in NI's own economic vision.

LHS has been identified as a priority sector - along with others such as Advanced Manufacturing, Fintech and Screen Industries.

The Northern Irish difference

With its unique niche specialisations, NI is carving out a distinct identity on the global LHS stage, presenting ample opportunities for innovation and advancement.

Northern Ireland's competitive advantages

Harnessing the Power of Specialised Niches

NI is emerging as a unique player in the global health sector, thanks to its naturally evolved niche specialisations. These niches, including clinical trials, MedTech, personalised medicine, and digital health, are not merely sectors where NI is excelling but are also powerful launchpads for deeper specialisation and innovation. As NI delves further into these niches, the convergence of specialised talent, focused resources, and rich knowledge becomes a powerful catalyst for advancement. The sectors identified below are not siloed strengths, but overlapping and are evidence of a symbiotic ecosystem across industry and academia.

1 MedTech and Diagnostics
NI's diagnostics sector features global players like Almac and Randox who employ over 10,300 globally. Locally, the industry employs over 2,500 people. Strong support from UU and Queen's University Belfast's (QUB), coupled with unique dual EU-UK market access post-EU exit, sets NI up for future growth.

2 Personalised Medicine
NI possesses deep expertise in personalised medicine, particularly in oncology and chronic diseases. QUB's Precision Medicine Centre , the UU's Personalised Medicine Centre and several local companies demonstrate expertise in developing and delivering advanced laboratory and digital technologies that can be applied to patient management decisions.

3 Digital Health
With over 40 digital health firms, including companies like Diaceutics, Cirdan, Cumulus, and B-Secur, and strengths in software development and cybersecurity, NI is poised to expand in the digital health space. The UU Living Lab will provide a launchpad for further R&D, with successful UU spin-outs such as Axial3D already having launched. Electronic care records will further enrich the ecosystem.

4 Clinical Trials | Aspirational
NI is making strides in clinical trials with around 20 companies involved. The scope of support, including the NI Clinical Research Network (NICRN), is expanding to encompass medical technology, diagnostics, personalised medicine, and digital health validation (detailed above), also reinforcing NI's core strengths in those areas.

5 Therapeutics | Aspirational
Whilst NI isn't as strong in the therapeutics sectors, its potential is immense. An increase in commercialisation expertise could catalyse stronger growth of the LHS sector.

LHS support services:

In addition to these core and aspirational areas of strength, NI's LHS sector is supported by a robust ecosystem of support services such as contract manufacturing, distribution and analytics, forming a foundational infrastructure that has underpinned the sector's growth to date.

Opportunity for growth is bolstered by its academic excellence, unique health system, start-up fostering environment, and industry collaboration.

Optimal Operating Environment

NI has distinguished itself as one of the most accessible, well connected, and collaborative LHS ecosystems in Europe. Its compact geography facilitates efficient travel within the UK and to other EU hubs such as Galway, Flanders, and others. Moreover, NI is one of the most cost-effective locations for businesses to operate within Europe, offering a competitive edge.

Impactful Academic Institutions

QUB and UU, both renowned for their strong output in LHS degrees, underpin the LHS sector in NI. These institutions support the ecosystem's growth and development by delivering tailored courses, nurturing high-quality graduates, and providing PhD students for industry placements. They also have a long track record in developing LHS intellectual property (IP) and creating spin-out companies.

For example, QUB recently ranked 2nd in the UK for entrepreneurial impact in 2022 by Octopus Ventures.[4] Additionally, its Research Excellence Framework (REF) impact scores in Bioscience place them in the top 5 for the UK.[5]

Similarly, Ulster University's Personalised Medicine Centre and the Biomedical Sciences Research Institute (BMSRI) contributed to Ulster University being ranked in the top 5 in the UK in terms of Research in REF 2021. 82.6% of research outputs were rated as either world-leading or internationally excellent [5a].

UU and QUB have robust established connections with Small and Medium Enterprises (SMEs) and Multinational Corporations (MNCs) worldwide, fostering collaboration and academic research.

Holistic Integrated Health Records

NI's health system assigns each patient a unique identifier and electronic health record (EHR). From 2023, an integrated care record system is being deployed, encompassing both health and social care records. This data-driven approach positions NI as a potential world leader in healthcare. The first Trust commenced operations in November 2023, with others following suit at six-month intervals. This unique system provides an access point for industry clinical trials and fosters academic-industry engagement within the healthcare system.

Entrepreneurial Acumen

NI has a strong reputation for fostering start-ups, particularly successful university spin-outs. The vibrant entrepreneurial culture found in NI fuels optimism for future growth and innovation.

One well-known example in the sector, HeartSine Technologies, which began life as a UU spin-out pioneering mobile coronary care technology – it was later acquired by Physio-Control and eventually Stryker, a leading manufacturer of emergency medical response products.

The NHS Clinical Entrepreneur Programme represents another pathway promoting entrepreneurship in LHS. This initiative offers support to staff of the Health and Social Care Trust (HSCT) and students pursuing healthcare degrees, enabling them to refine their innovative ideas. It includes providing valuable advice on IP protection and business planning. Available to participants in NI since 2021, the programme has been enthusiastically supported and facilitated by HIRANI.

Organisations such as HIRANI play a pivotal role in fostering cohesion within the sector. Beyond promoting unity, HIRANI is crucial in leading major initiatives, as evidenced by their recent involvement in the £7.5M Launchpad bid. They also enhance connectivity to showcase capabilities and access support for UK and Ireland LHS activities, thereby strategically positioning NI as a global hub for LHS.

Opportunities for growth are also enhanced by government agencies supporting the sector, coupled with the investments made available through the City and Growth Deals

Supportive Government Agencies

Invest NI, NI's regional economic development agency, excels in attracting Foreign Direct Investment (FDI) to the LHS sector. Its support ranges from rapid funding for indigenous firms to research and development (R&D) grants, broader financial and operational assistance, and facilitating strategic international networking opportunities. Incorporating additional specialist insights into LHS industries and research could further augment Invest NI's effectiveness in attracting more LHS FDI across the ecosystem.

Matrix, of course, is also noteworthy. We are an industry panel, convened under the Department for the Economy (DfE), to help it build the evidence base for future innovation policy, including in the LHS sector.

Government Investments

The UK Government's 'Levelling Up' agenda seeks to bolster economic dynamism and innovation across the country. The CGDs form a part of this mission by stimulating economic growth in specific areas. Moreover, the plans developed under the CGDs for NI, sees a substantial proportion of investment earmarked for the LHS sector (>£200m), which reflects the aspiration to enhance and bring innovation to the forefront of NI's LHS offerings.

Enabling true potential

NI's LHS sector is poised for success, with opportunities to develop a unified vision, better understand its regional strengths, drive cross-sector collaboration, and define its sector value proposition to the wider UK and international audience.

Opportunities to grow

When viewed holistically, NI has a strong foundation to establish itself as one of the most competitive, vibrant, and focused LHS clusters in Europe. However, there is always room for advancement. Key opportunities for growth include:

- drive greater ecosystem unity
- align academia more closely with industry
- balance indigenous growth and FDI

These opportunities necessitate strategic and tactical solutions to leverage the sector's strengths and address barriers to growth.

Drive greater ecosystem unity

The LHS sector in NI has many ingredients essential for success, but it could greater enable cohesive thinking among various stakeholders. There is a key opportunity to produce a unified, long-term vision similar to the Life Science Vision published by the UK.

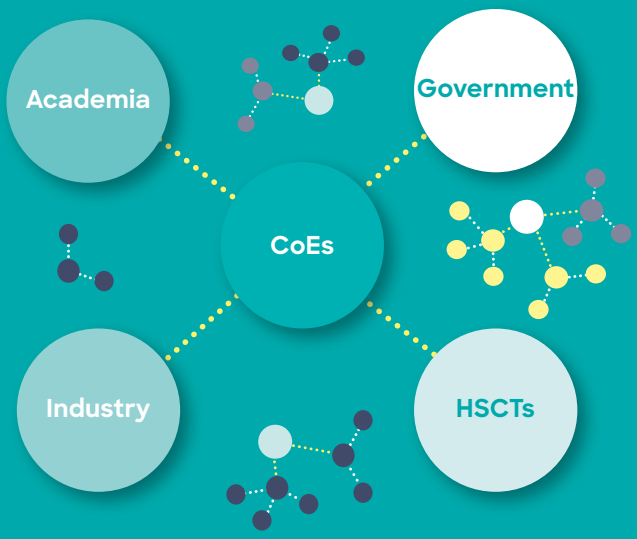
This opportunity for greater unity manifests itself in various ways. Players in the region could enhance their knowledge and understanding of the strengths within the whole NI ecosystem. The development of a common forum with appropriate resourcing could enhance cross-sector collaboration and networking, increasing the opportunities to broadcast NI strengths and opportunities nationally and internationally. There are also opportunities to greater identify cross-sector innovation. Lastly, a consistent and aligned communication strategy placing the NI LHS sector alongside the rest of the UK, external industry, and the international economy (EU, the United States (US), Asia) could effectively broadcast the collective achievements of NI.

As highlighted by one consultee: "The key members within NI probably haven't all met and are unaware of a common voice or value proposition for the region." In particular, representatives from the Health Trusts expressed opportunities for greater inclusion to help influence the path for the LHS sector to date, given the health system's potential as an innovation partner and its incentive to create better health outcomes for the citizens of NI.

Industry consultees agreed with health and academic consultees, sharing their view that HIRANI has made considerable progress in driving ecosystem unity.

The opportunity for greater collaboration is also present for the CGDs, which will be examined further in this report. Many consultees expressed a willingness to further engage in CGD initiatives, highlighting the enthusiasm of the sector.

NI's LHS ecosystem



While the LHS sector in NI thrives on the strong support from universities, increasing student places and the opportunity to closer align academic programs with industry demands could help drive further growth.

Aligning academia more closely with industry

NI's education system is proven to be a prolific source of skilled graduates eager to make their mark in the LHS industry. A thriving LHS ecosystem requires expertise in a diverse range of skills including basic scientific methods, clinical research and trial implementation, digital tech, bioinformatics and biostatistics, project management, quality, regulatory, business development, legal affairs, and entrepreneurism. Internationally recognised universities such as QUB and UU are primary contributors to the region's LHS cluster, shaping a robust and active ecosystem. They achieve this through an innovative educational system that constantly supplies a wealth of highly skilled graduates and PhDs, fuelling innovation and supporting the industry's growth.

One of the remarkable strengths of NI's educational system is the incorporation of industry experience into study programs. Many courses at both universities have placement programmes, which are highly valued by the industry for the practical experience they provide. Placements can range from three-months to one year, with selected degrees in UU having compulsory one year placement requirements. For example:

- MSci in Biochemistry with Professional Studies at QUB: A five-year undergraduate programme in which students must complete a 16-week work placement.
- BSc (Hons) in Biomedical Science with placement year at UU: A four-year degree programme in which students undertake a placement in either industry or a research institute.

Owing to the success of such programmes, there is a call from stakeholders for more of these types of degrees, as well as extending the placements to a standard length of 12 months. This would allow students to be more effectively onboarded, contribute significantly to their placement companies, and increase their employability upon graduation. Still, certain challenges need to be addressed.

Undergraduate

One of the most pressing is the cap on annual student places across NI's universities, currently set between 6,000 and 7,000. The NI Affairs Committee of the House of Commons has identified this as a potential area for improvement.[6] Increasing this cap could greatly augment the region's LHS workforce, satisfying a rising demand for such skills.

Undergraduate courses could also benefit from alignment with NI's niche strengths. The need for talent with niche skills has compelled companies to design their own graduate schemes. For example, Exploristics, a global leader in bio-simulation software and biostatistics services, have begun to address this issue by setting up a graduate academy, thus directly meeting their business's demands for specific skill sets.

Postgraduate

Similar to undergraduates, the LHS sector in NI has a key opportunity to increase integration of academia and industrial innovation at the PhD level. The implementation of a rotational period for PhD students across NI could significantly contribute to better academia-industry alignment. Such an initiative would facilitate a mutual exchange of cutting-edge technological knowledge, allowing industry to benefit from the latest academic insights, while giving universities an understanding of current industry trends.

Furthermore, NI's vibrant LHS community can bolster its development by forging strategic partnerships with industry. A noteworthy instance is the partnership between UU and Dell Technologies since 2020, which aims to advance digital health research.

Spin-outs and IP

Universities can also function as incubators for products and devices, fostering a thriving start-up ecosystem through the IP they generate. Queen's University Belfast Innovation Society (QUBIS) and Innovation Ulster Ltd (IUL), have a history of successful spin-outs in the pharmaceutical, personalised medicine, and digital health sectors, supporting the translation of research into impactful commercial ventures. Striking a balance in equity shares taken in these incubated start-ups is crucial for motivating academics and entrepreneurs to achieve their goals, with university IP rights needing to reflect investor and inventor ownership rights. In addition, the academic ecosystem provides access to clinical academics, who can support and lead clinical trials in the region, further supporting the commercial launch of products.

In the face of global competition for FDI, NI's LHS sector grapples with obstacles such as a lack of significant FDI presence in the sector, lack of vision, EU exit related uncertainties, along with the need to better nurture its indigenous companies.

Balancing indigenous growth and foreign direct investment

NI's LHS sector finds itself in a globally competitive space, vying against other LHS hubs such as Newcastle in England and internationally, like Singapore, to attract FDI. Both these hubs, along with others, are profiled in detail in section six for reference. A critical part of establishing a vibrant ecosystem involves attracting major FDI players.

Foreign Direct Investment

One of the key opportunities for NI is in attracting large FDI organisations to operate within the region, which would further drive NI's economic development. A criterion for achieving this is often a comprehensive and interconnected ecosystem, which NI has the opportunity to create to establish itself as a recognised LHS hub globally.

NI's unique proposition to potential FDI and the demonstration of its expertise in specific niches needs to be more pronounced. This requires the region to weave its assets into a cohesive network, providing a robust case for FDI.

Following the EU exit, the regulatory changes in NI open up fresh avenues for growth and development, offering new prospects for progress and expansion.

The Windsor Framework and political stability provide positive clarity on trade and the movement of goods between jurisdictions. NI's new dual market access status necessitates a bold, entrepreneurial clarification to industry and FDI that this is a unique opportunity for business. The region's regulatory frameworks will also benefit from clear articulation and a roadmap for the industry, covering diverse areas from digital health to clinical trials. Ongoing support is required from the UK government and Medicines and Healthcare products Regulatory Agency (MHRA) as regulations shift across the EU and UK, with NI potentially requiring additional funding to establish its own LHS regulatory advocate, due to its unique positioning.

Indigenous firms

Simultaneously, NI can further nurture its indigenous LHS firms. These smaller, local companies have expressed high interest in funding processes and how they relate to SMEs. They hope that the funds allocated to the CGDs will also consider their unique needs and the opportunities available to them.

To create a competitive advantage and a thriving ecosystem, it's crucial to focus on these small businesses and to support their innovation and skill development. A flourishing indigenous start-up and SME scene can draw considerable attention from large pharmaceuticals and FDI.

Seed investment funding provides essential capital to start-ups allowing for development and growth.

NI's seed funding availability is lacking compared to other regions, creating a financial challenge to businesses in the region. Consequently, there is an exciting opportunity to ensure that SMEs are fully engaged in the CGDs. When SMEs actively participate, they can thrive and expand within NI's business landscape. This, in turn, contributes to a robust job market, allowing them to compete effectively with FDI and larger indigenous firms. By embracing both FDI attraction and the nurturing of indigenous growth, a solid foundation for the prosperous future of the LHS sector can be laid in NI. For instance, the Centre for Digital Healthcare Technology (CDHT) at UU, which currently interfaces with approximately 40 LHS SMEs, serves as an inspiring model for enhanced indigenous business engagement and collaboration.

03

The City and Growth Deals

Overview of the City & Growth Deals

The CGDs offer NI the opportunity to shape its own economic development. In keeping with the 30+ previous deals across the UK, NI will receive funding, significant input on its use, and the prospect of further devolution of development.

City and Growth Deals

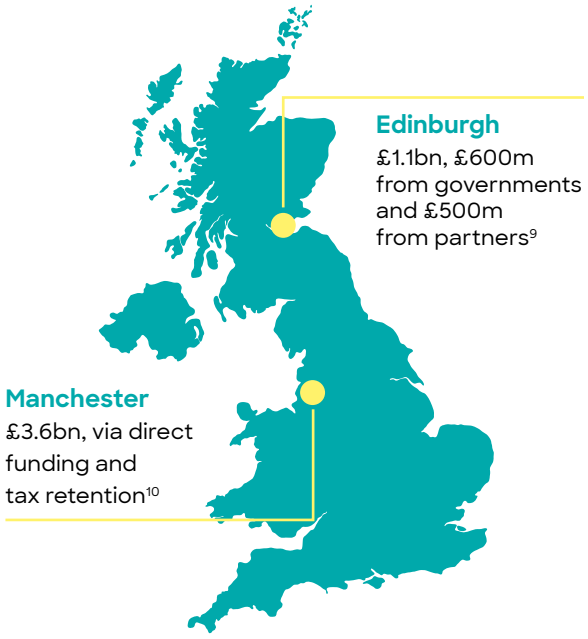
What the deals are and how they work

The CGDs were born out of the view that each city or region is unique, with different needs, opportunities, and advantages. The CGDs aim to shift economic development "away from a one-size-fits-all model" and entrust development to local councils, who know their area best. Over 30 have been successfully negotiated so far, with local councils submitting plans to UK central government and receiving funds and the authority to invest in major capital expenditure.[7] Since launching in 2011, CGDs have been established in all major and fast-growing cities in England, and have now branched to Wales, Scotland, and NI. These CGDs are not sector-specific, instead seeking to draw on the relative strengths of each region.

Example City and Growth Deals across the UK

Edinburgh and South-East Scotland's Deal included funding for a new University of Edinburgh building in the BioQuarter, to focus on data-driven health research. A venture studio is also being established at the Roslin Innovation Centre, the science park and commercial arm of the institute where Dolly the sheep was cloned in 1996. The Edinburgh BioQuarter helped grow a £100m+ health-focused venture capital fund called Epidarex. This shows that CGDs can lead to more money for local firms, as start-up communities can form around specific investments.

Manchester's CGD had substantial LHS elements, including the establishment of a £40m LHS investment fund, and the formation of the public, private, academic, and clinical Manchester Science Partnerships.[8] Research clusters were underpinned by real estate provided by Bruntwood SciTech. A 2023 "Trailblazer" extension deal granted Manchester increased autonomy and greater tax retention. Going forward, Manchester will state its research and innovation priorities to government science ministers, as well as embark on enhanced collaboration with UK Research and Innovation (UKRI). This will allow funding to be directed in a manner that takes account of the region's strengths and goals. Manchester's CGD has helped create up to 6,250 jobs across multiple sectors and up to £210m public and private sector investment for the region. 8 Similar positive outcomes could be an end state goal for NI as a result of the CGDs.



Example: Manchester CGD funding timeline[10]

This additional funding will be used to maintain momentum in Manchester's CGD.

2012 City Deal valued at £900m

2014 Growth Deal £476m

2015 Growth Deal £56m

2016 Growth Deal £130m

2023 Trailblazer Deal valued at £2bn

LHS relevant CoEs within the CGDs

The CGDs are a unique opportunity for cross-sector collaboration for NI, with the interlinking of digital, automation, LHS and medicine joining together within CoE. Each centre could act as a focal point of excellence per speciality.

CoEs across NI

Several CGDs have been agreed for NI. These investments are broadly aligned to priority industry sectors of NI's economic strategy.

Funding under the CGDs requires submission of a business case for approval of funds by the Department of Treasury, Department for Education and Department of Finance. The CGDs are capital spending projects supported by local councils, with universities typically (but not necessarily) providing the infrastructure required for CoEs. CGDs are governed by local councils, which outline the goals and KPIs for each CoE in the approved business cases, providing targets for each CoEs. Below are the key LHS-focused CoEs.

Belfast Region CoEs

Centre for Digital Healthcare Technology (CDHT)

CDHT has gained £34m in BRCD contribution, with CDHT acting as the envelope for Connect Health and Innovation Centre (CHIC), Eastern Corridor Medical Engineering Centre (ECME), SERG and Nanotechnology and Integrated Bioengineering Centre (NIBEC). [11]

CDHT and the clinical Living Lab infrastructure, will help increase innovation in digital health, medical technology devices and diagnostics. It will link clinicians, academics and industry experts to accelerate early-stage clinical innovation.

Institute for Research Excellence in Advanced Clinical Healthcare (iREACH)

iReach aims to streamline clinical trials and provide a single contact point for industry to conduct clinical research. iREACH has gained £39.7m in BRCD contribution. [11]

Global Innovation Institute (GII)

GII aims to apply data and analytics to agrifood, health, and digital technology. It will create 10,500m2 of state-of-the-art facility, which has gained £78.7m in BRCD contribution. [11]

Advanced Manufacturing Innovation Centre (AMIC)

AMIC is a centre for high-tech manufacturing, including spaces to experiment with digital twinning and prototype tech. AMIC has gained £78.7m in BRCD contribution. [11]

> "The City Deals' real magic is in the landscape and ecosystem they could provide to NI, not just in a single project.
>
> *Dept. for the Economy consultee*

> "These Deals are great for NI, but let us understand the pillars we build and be brave when we invest.
>
> *Academic consultee*

Legend

The LHS sector is the primary focus of the CoE

The LHS sector is relevant to the CoE, but may not be its main focus

Note: The above information reflects aspects of the CGDs which are considered relevant to the LHS ecosystem; it may not be exhaustive. CGD information is in line with information publicly available as of July 2023. The CoEs may be subject to change as the CGDs evolve and become fully operationalised.

The CGDs are a unique opportunity for cross-sector collaboration for NI, with the interlinking of digital, automation, LHS and medicine joining together within CoE. Each centre could act as a focal point of excellence per speciality.

Derry City and Strabane CoEs

School of Medicine

The School of Medicine delivers education and research, graduating its first new doctors into the North West in 2025. It will deliver BSc and MSc courses in personalised medicine as well as industry facing short courses. It will also build research capacity through the Personalised Medicine Centre, which is a long-standing centre of excellence in personalised medicine and genomics.

Cognitive Analytics Research Laboratory (CARL)

Will provide cutting-edge technology within artificial intelligence (AI) in multidisciplinary fields across industry.

Centre for Industrial Digitalisation, Robotics and Automation (CIDRA)

Located at UU, CIDRA will provide a state-of-the-art facility for industrial digitalisation, robotics, and automation. CIDRA will partner with local business to further enhance NI's digital skills within the economy.

Mid South West Region Growth Deal CoEs

CAFRE NI Agrifood Robotics Centre (NIARC)

A robotics centre to explore, trial, and innovate in applying automation to agrifood processing.

Agri-Tech Innovation Centre

This centre will innovate in agricultural technologies, led by the research provider, the Agrifood and Biosciences Institute (AFBI).

Engineering Skills and Innovation Centre (ESIC)

Linked to the AMIC, the South West College will lead this engineering focused CoE to educate the manufacturing workforce.

Causeway Coast and Glens

The Causeway Coast and Glens Growth Deal is another CGD set to receive £72m in funding, with six key themes identified to assist the local economy. These are: Innovation, Tourism and Regeneration, Infrastructure, Employability and Skills, Digital Connectivity and Energy. Full details of the deal and CoE are not in the public domain. Further news and details surrounding the CoE's are to be released, providing greater insight and collaboration opportunities for industry. [12]

Centre for Food and Drug Discovery (CFDD)

Linked to UU, this CoE will provide drug discovery and pharmaceutical innovation collaboration opportunities.

Foodovation Cente

Located at North West Regional College, is a new state-of-the-art R&D centre offering food innovation, science and technology development opportunities.

This report specifically focuses on LHS-specific CGDs. However, it's important for readers to be aware that these CGDs are part of a larger landscape of CGD investments aligned with the Department for the Economy's economic vision. For instance, Studio Ulster is an initiative being developed as part of the Belfast City Region Deal and is in alignment with the identification of Screen Industries as a priority sector. The role of non-LHS focused CoEs on progressing LHS objectives is yet to be fully teased out.

Note: The above information reflects aspects of the CGDs which are considered relevant to the LHS ecosystem; it may not be exhaustive. CGD information is in line with information publicly available as of July 2023. The CoEs may be subject to change as the CGDs evolve and become fully operationalised.

The CGDs are a unique opportunity for The CoEs under the CGDs provide opportunity for enhanced collaboration between industry and academia, while growing NI's reputation as a LHS ecosystem.

Northern Ireland's Centres of Excellences

Embracing the power of the CoEs

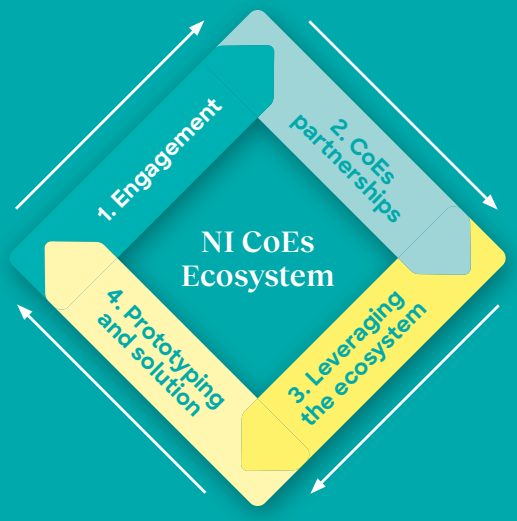
The CoEs ecosystem in NI creates a unique chance to establish NI as a world leading LHS hub, with access to LHS experts and cutting-edge technology. Expertise embedded in the CoEs creates a dynamic environment for industry and academia to problem solve, prototype and create industrial focused answers for the development of patient care. The CGDs provide the opportunity to create regional areas of excellence in LHS through the CoEs, by adding additional economic, social and academic opportunity across the NI ecosystem.

1. **Identification of Industrial Projects**
Increased opportunity for a single mechanism to facilitate the engagement of indigenous and foreign organisations with CoEs across NI, enabling them to provide expert insight, research capabilities and cutting-edge technology either individually or collectively.

2. **Creating a CoE partnership**
Partnership development between industry and CoEs will help to align academia and LHS industry towards a joint focus. Partnerships between academia and industry in the CoEs will create enhanced opportunities for knowledge sharing and upskilling across the NI LHS skills ecosystem.

3. **Utilising CoEs Ecosystem**
The CoEs ecosystem provides a range of specialities from applied data analytics (e.g. in GII) to personalised medicine and genomics (e.g. in UU's School of Medicine), ensuring industry has access to LHS experts across a wide range of specialities.

4. **Solution Testing**
The CoEs provide industry and academia with an environment and capability to test and develop new products and solutions, which can be implemented across the NI ecosystem. For example, clinical trials through iReach or medical device prototyping at CDHT.



	Example therapeutics pathway	Example Medtech pathway
1.	Industrial engagement with LHS sector	Industrial engagement with LHS sector
2.	Identification of relevant CoE across the CGDs	Identification of relevant CoE across the CGDs
3.	UU School of Medicine	CARL
4.	iREACH	CDHT

[a] The therapeutic and medical device pathways provided are examples only. It is envisaged that CoEs can be leveraged based on the expertise needed to maximise development of the LHS product.

Attitudes to the City and Growth Deals

NI stakeholders would like the CGDs to be guided by an overall vision and strategy so as to better articulate their strengths, leading to a recommendation for the development of a more coherent narrative for LHS for the region.

Awareness of the deals within the NI LHS ecosystem

Our survey indicates that 60% of stakeholders in the NI LHS sector are aware of the LHS CGDs. We anticipate an increase in awareness and marketing efforts as the CGDs progress further, and their role continues to evolve in the NI ecosystem. [1]

Clarity of overall strategy

The most cited view of the NI LHS ecosystem participants expressed regarding the CGDs is the need for a clear vision with a well-defined strategy and the deals to guide their execution.

During our consultation process, we received feedback from a number of stakeholders who expressed a desire to know more about the CGDs, as well as better understand the criteria used to determine the focus areas of the CoEs. It is important to avoid the perception that the CoEs established under the deals have overlapping focus areas and broad remits, which would make it challenging for NI to communicate a coherent LHS proposition.

Stakeholders recommend that the CGDs concentrate their funding efforts on a few key pillars that align with NI's strengths, which will mature over time. This focused approach will prevent the dilution of capital and ensure that the ecosystems developed are exceptional.

Some consultations touched on the importance of addressing local issues and priorities within the CGDs. For example, many people in NI face social deprivation, driven by socio-economic circumstances. By addressing the specific needs and challenges faced by communities within the region, the initiatives can create more meaningful and lasting impact.

Accelerating the pace of progress

There is an acknowledgement that speed will be crucial in the implementation of the CGDs in NI. Fast implementation is necessary to quickly identify what works and make adjustments as needed.

Stakeholders compared the progress of the CGDs in NI with other regions, highlighting the need to learn from best practices and adopt effective strategies to accelerate implementation.

Stakeholders advocate for ambitious and agile deals, balancing proven capabilities and innovation; with interest in staying informed over time as the CGDs evolve and mature from capital builds to fully fledged centres.

Operational savviness and agility

Balancing objectives: Stakeholders argue that the CGDs could be more ambitious, taking calculated risks to achieve significant outcomes. They propose adopting an 80:20 rule, where 80% of the efforts focus on proven capabilities and 20% on innovative, higher-risk ideas.

Adaptability: Stakeholders suggest that the deals take an agile approach to allocating resources, adjusting investments based on the performance and potential of different initiatives. This flexibility enables stakeholders to capitalise on emerging opportunities and pivot when needed.

Monitoring and evaluation: By maintaining a focus on delivering purposeful and action-oriented outcomes, the CoEs can drive tangible progress and contribute to the success of the CGDs. Stakeholders emphasise the importance of establishing robust monitoring and evaluation processes for the CGDs to track progress, assess the impact of initiatives, and make data-driven decisions for continuous improvement.

Talent and skills

Attracting talent, retaining top talent and building a relevant skills base in NI will be essential for driving continued innovation and growth in the LHS sector - many within NI's LHS sector see the CGDs playing a key role in that effort.

By working closely with universities and research institutions through the CoEs, LHS industry partners should be able to access cutting-edge research, resources, and a talent pool that can drive innovation and growth. Many hope that the deals will also incorporate apprenticeship programs, which are an effective way to reskill and bring in new talent to industry sectors.

Ultimately, the CGDs could also play an important role in promoting NI as a global destination for attracting LHS professionals.

Various strategies and schemes already exist for higher education, further education and apprenticeships in NI. It will be essential that the CGD orchestrators are aligned with the vision set out in the Department for the Economy's Skills Strategy and existing associated action plans.

Longevity and sustainability

The CGDs promise to bring a significant boost of capital expenditure to the NI LHS sector, marking a new chapter of growth and development. They will enhance existing LHS infrastructure with new buildings and advanced equipment, while also supporting continuous progress through facility maintenance, skilled workforce employment, and efficient operations. These capital projects, initially fuelled by significant capital funding, are designed to evolve, incorporating revenue generation strategies for operational expenses, and gradually transforming into financially independent centres.

Some consultees suggest adopting a deliberate commercial mindset. This would involve establishing commercialisation offices, similar to those already present in academic institutions. However, these offices would have a specific role in facilitating the transfer of industry-relevant discoveries, knowledge, and IP. The aim is to adopt a model like the one used by Scripps in San Diego, which involves engaging industry and researchers through more compelling means. This could include flexible technology transfer arrangements, preferential licensing options, reduced royalty fees, and other similar measures.

> "When venture capital firms visit NI from London or Silicon Valley, our CoEs will be hubs to which we can bring them; presently our enterprises and innovators are fragmented across the province.
>
> *Indigenous LHS sector consultee*

Inclusiveness and collaboration across the ecosystem will be key, with expectations ranging from greater supports for SMEs, further aligning academic research with industry demands, and more involvement of healthcare trusts in the CGDs.

Inclusiveness and collaboration across the NI LHS ecosystem

Stakeholders emphasise the importance of forging strong partnerships among businesses, academia, public institutions, and other stakeholders to drive collaborative efforts in the CGDs. They advocate for shared leadership of the CoEs, co-creation and joint development of projects within the CGDs, leveraging the strengths of all partners involved.

Industry: By fostering close relationships with large LHS industry partners, particularly multinational pharmaceutical companies, the CoEs could better understand and address the needs of the industry, ultimately driving more impactful outcomes.

Many stakeholders noted that the deals must be fully engaged with larger ecosystem players to maximise their potential, which could lead to a mismatch between the initiatives' focus areas and the actual needs of the industry.

SMEs: SMEs are eager to take on a more substantial role within the CGDs to guarantee that their interests are adequately represented, ensuring a fair distribution of benefits and promoting widespread growth in NI.

Health and Social Care Trusts: Many noted that the involvement of the HSCT will be important for the successful implementation of initiatives related to LHS within the CGDs. Trusts could support the integration of new prototypes and innovations within the industry, potentially by running them alongside established techniques. This would enable the LHS sector to demonstrate the benefits and cost-effectiveness of new innovations more efficiently.

With regional strength in digital health, the sector is ready for further progress in adopting digital technologies within NI's healthcare system. Consultees have suggested that Digital Health and Care NI, which oversees the trusts' central budget for digital investments could be utilised to further drive digital innovation across all Trusts.

Academia: By actively participating in the CGDs, the universities in NI are working to create a supportive ecosystem that fosters innovation, economic growth, and a strong foundation for future development in NI.

There is further potential for these institutions to identify and harness their unique strengths to foster entrepreneurship, and innovation to catalyse further growth of the LHS sector in the region. Specifically, stakeholders mentioned that there is scope to better align research with industry demands and quicker identification of potential spin-out opportunities. The commercialisation of R&D could be improved by consulting industry experts at earlier stages, implementing rotational periods into industry organisations for PhD students, and incentivising academics to focus on commercial outcomes.

Along with aligning on goals and objectives with the CoEs, stakeholders emphasised that trust and transparency will be essential to successful collaboration in the CGDs. By being open about their intentions, sharing information, and demonstrating commitment to the partnership, the various players in the NI LHS ecosystem can build trust, which in turn enables more effective collaboration.

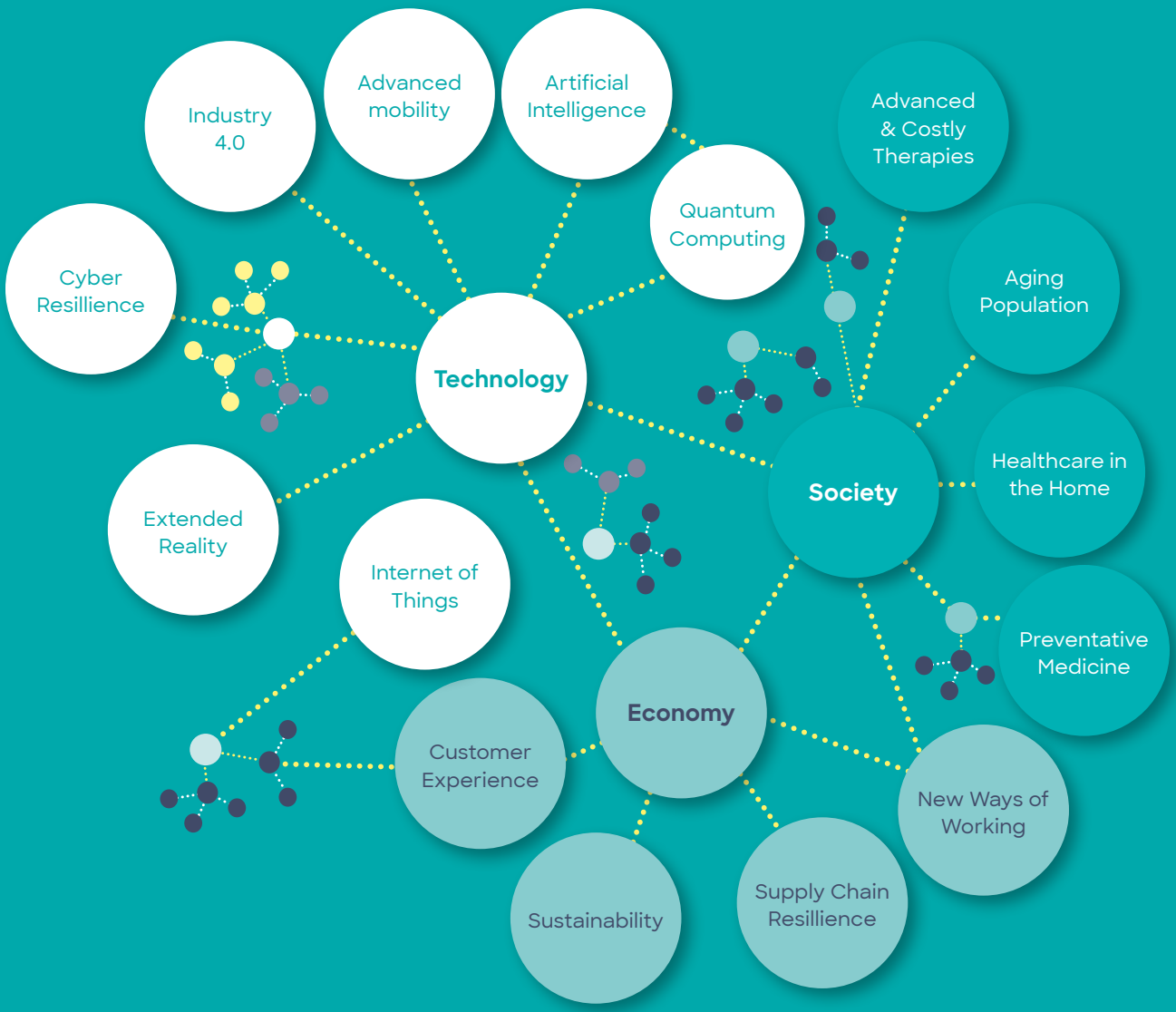
Leadership and accountability: To maximise the impact of the CGDs on NI's LHS ecosystem, many stakeholders expressed that local councils should more closely align to ensure the CGD infrastructure is not only operationalised but coordinated and leveraged for rapid commercial translation of LHS technologies, business development for the region and horizon scanning.

04

Alignment of Deals with Macro Trends

Macrotrends

Macrotrends are powerful forces shaping our world, including technological advancements, economic and commercial developments, and social shifts, with implications for individuals, policymakers and organisations across industry sectors.



Anticipating how global macrotrends could reshape the LHS sector

This section provides an overview of key macrotrends that have been identified as significant and influential at a global level across a variety of thematic areas. The trends discussed within this section are not exhaustive and are selected to offer a robust but digestible understanding of the major, widespread changes that are occurring internationally. This section aims to highlight these macro shifts from a broad perspective, given their potential impact on the future direction of NI's LHS CGDs, and is not meant to provide an in-depth analysis.

Technology macrotrends

Technology produces new markets and renders old ones obsolete, resulting in both challenges and opportunities. The defining feature of our era is its digital nature, which touches on artificial intelligence, cyber resilience and extended reality.

Artificial Intelligence

The applications of AI are mainly in scenarios where large volumes of data exist. This now encompasses a broad variety of LHS due to the rise of big data in genomics, proteomics, and enhanced technology.

Personalised Medicine

We expect to see AI applied in almost all aspects of LHS from R&D to manufacturing to the clinic. The big data and AI revolution will particularly impact on personalised medicine. Decreasing sequencing costs will permit genomic, proteomic, and transcriptomic data generation per person, which will be combined with tech-derived data from wearables and other sources. AI will play a key role in sifting through this enormity of data to find the medicine or intervention best suited to that individual.

Cyber resilience

The ability to withstand cyber-attacks will be crucial for all organisations in the future, especially large government providers who are particular targets for hackers. The cyber-attacks of the Republic of Ireland (RoI) Health Service Executive (HSE) in 2021 and the UK's NHS in 2022 acutely illustrate this point.

Digital Health

The rise of Software-as-a-Medical-Device points towards the acceptance of data's importance in healthcare. However, this comes with severe cybersecurity concerns. In October 2021, Medtronic recalled 31,310 insulin pumps across the US after it was revealed these could be remotely triggered by third parties, potentially causing a fatal surge of insulin to a patient. [13] As the world's leading investment location of US cybersecurity, NI can and must apply its capabilities in this field.

Extended Reality

Extended Reality (XR) refers to approaches where a user is immersed in a three-dimensional virtual environment, either self-contained or laid on top of the physical world.

Digital Health

Far from a gimmick or fad, XR is a very real phenomenon in LHS, with ~40 Food and Drug Administration (FDA)-approved extended reality devices. [14] These are extensively used for preprocedural planning and real-time surgical guidance. Companies such as XRHealth are exploring psychological and physiotherapeutic treatments via XR. Several researchers have also produced XR applications to visualise genomic (VRNetzer), proteomic (BioVR), and other big data. The first operating-room extended reality device, the MagicLeap 2, was approved in January 2023. The industry is in its infancy, valued at ~£2bn globally. [15]

Advanced Mobility

Connectivity via drones, small aircraft, and other means are increasingly prevalent with as many as 800m passengers expected by 2040, mainly in large metros. [16]

Clinical Trials

One study interviewing leaders of failed trials stated over half of trials had unrealistic, overoptimistic recruitment estimates. A highly specialised trial, such as in personalised medicine, may only have a few dozen patients nationwide, and an entire industry exists solely to arrange clinical trial transport and travel. But what if rapid, place to place, bespoke air travel was brought to clinical trials? Advanced mobility could revolutionise the speed of trials where small numbers are concerned.

Personalised Medicine and Manufacturing

A number of companies are already experimenting with drones for manufacturing purposes, mainly to rapidly ship components between sites. A small, cold-chain equipped drone could be a vital part of the personalised medicine supply chain, bringing therapies from factory to physician in record time. Close to home, the Care & Equity - Healthcare Logistics Unmanned Aircraft System Scotland (CAELUS) consortium has united the NHS, industry, and airports to use drones to deliver care in rural areas, via transport of medicines and samples.

Automation of high-tech personalised and regenerative medicines will drive their adoption and use, potentially supplanting older, less technologically advanced therapies.
The digitalisation of healthcare will enable clinical trial's integration into everyday life.

Industry 4.0

Industry 4.0 represents a paradigm shift in the manufacturing sector, characterised by the integration of automation, pervasive interconnectivity, and innovative industrial procedures such as additive manufacturing.

Manufacturing

One key pillar of Industry 4.0 is the automation of manufacturing through advanced robotics. These smart machines, driven by cutting-edge AI, are expected to redefine not only manufacturing but virtually all human activity, including LHS. Despite significant strides in automation, this revolution is far from over. An astounding 65% of the ~750 billion hours devoted annually to global manufacturing activities remains susceptible to automation. [17]

The potential of Industry 4.0 is fully unlocked only through hyper-connectivity - a state achieved by the amalgamation of industrial ethernet networks and emergent wireless technologies like 5G, or even low-power wide area networks. This hyper-connectivity allows for seamless data exchange and integration of different systems in real-time, leading to efficient and agile production.

Another transformative aspect of Industry 4.0 is the implementation of new industrial processes, including additive manufacturing. Often referred to as 3D printing, it involves layer-by-layer construction of three-dimensional components directly from a digital blueprint. This is vividly demonstrated in the MedTech industry with the production of customised prosthetics.

The CGD-funded AMIC at QUB offers substantial collaboration potential for Industry 4.0 related innovation in the LHS CoEs.

Personalised Medicine and Regenerative Medicine

The manufacture of advanced therapy medicinal product (ATMP) and CGTs remains, for the most part, manually performed by biotechnicians trained to handle stem cells. Robotic solutions are still small and do not span the entire bioprocess. Projects such as AIDPATH, an international consortium of 14 universities across eight countries, seek to develop mechanised and AI-driven cell therapy manufacturing platforms, in order to unlock mass-scale and less expensive ATMP production. [18] The mass production of advanced therapies will resolve many of the concerns over pricing and reimbursement that have stymied the development of such treatments, paving the way for mass adoption.

Internet of Things

The Internet of Things (IoT) represents a transformative macrotrend within LHS, giving rise to the increasingly relevant term "Internet of Medical Things." At its core, IoT refers to the interconnectedness of sensors and devices, monitoring and controlling various aspects of the environment, the things that move within it, and the people that act within it.

Clinical Trials

Within the LHS sector, wearables like smartwatches and health apps are becoming integral parts of patient care, allowing individuals to track vital metrics such as heart rate and sleep.

It is likely that cruder measures of patient wellbeing, like regular clinic visits for blood pressure readings or Patient Reported Outcomes, will be phased out in favour of seamless approaches like automated readings and device push notifications.

This enhanced data will allow finer, more intelligent clinical trials, and will carry over into general medical practice as well. Already, devices like the Apple Watch have been used in clinical trials to monitor serious heart conditions.

Digital health

The impact of IoT extends beyond personal tracking and clinical trials. Remote patient monitoring, smart healthcare facilities, medication management, and telemedicine are also becoming essential in modern healthcare practices.

This trend is steering a shift towards consumer-led diagnosis and treatment, with people taking control of their healthcare and using technology for self-treatment where possible. Although it is still early days, the integration of IoT in healthcare systems signifies a move towards more proactive, preventative and personalised medical care, thereby enhancing patient outcomes.

NI has embraced this trend, with organisations like the CDHT and NI CHIC providing platforms to innovate and boost healthcare technology, including IoT applications.

Quantum computing is an exciting emerging technology that offers innovative solutions for complex medical challenges, from processing genomic data to enhancing medical device security and revolutionising clinical simulations.

Quantum Computing

Quantum computing, an alternate approach to solving complex mathematical problems involving vast amounts of data, represents a potentially ground-breaking megatrend in the field of LHS. Relying on the principles of quantum mechanics, this innovative technology is only beginning to transition from demonstrations to practical applications. The potential implications for NI's LHS sector are immense, as it explores cutting-edge solutions to long standing challenges in medical research, diagnostics, and treatment.

Personalised Medicine

In the realm of personalised medicine, quantum computing offers a glimpse into the future of tailored medical solutions. It could be instrumental in NI's ongoing pursuit of advanced healthcare by unlocking the ability to process complex genomic data swiftly. This approach could significantly improve disease detection rates and reduce the burden on healthcare professionals when diagnosing ailments based on patient-specific data.

MedTech

The MedTech sector, which is also a strength of NI, may also see early applications of quantum computing in areas such as medical imaging analysis and enhancing the security of medical devices.

Clinical Trials

The promise of quantum computing extends to completely revolutionising clinical trials. While current technology cannot fully simulate clinical trials, the development of 'virtual humans' and complete simulations could soon be within reach, driven by advances in quantum computing. NI's LHS sector, which has an aspiration to build unique propositions for clinical trials, could be at the forefront of this transformation, yielding major benefits over traditional in vivo trials.

Economic macrotrends

The world economy is facing unprecedented change, with companies navigating challenges such as the demands of sustainability, heightened customer expectations, and new ways of working.

Customer Experience

The LHS sector increasingly accepts the need for customers and patients to have input on the services and products offered to them. Healthcare has experienced a shift away from the "paternalistic" model of activity towards a collaborative patient-physician approach. Customers demand easier interactions with LHS providers, pushing for enhanced patient centred service offerings, through digital platforms.

Personalised Medicine

Personalised Medicine is the very definition of a customer-driven industry; ideally, each intervention is unique. If this is to be a reality, providers must be able, and patients willing, to use patient data pertaining to genetics, weight, medical history, age, and more. To lead in this field, NI will need a trustworthy service which caters both to LHS companies and the patients they depend on.

Clinical Trials

The understanding that not all patients are the same is trickling through to regulators, with the FDA declining to approve Eli Lilly's Tyvyt lung cancer drug in 2022 on the grounds that its ORIENT-11 trial lacked ethnic diversity comparable to the US. Although NI's population is relatively ethnically homogenous, diversity in age, medical history, and other factors is increasingly likely to come into play in regulatory decisions. A clinical trial infrastructure that includes all citizens will address this need for diversity.

Digital Health

Increasing concerns over privacy, safety, and "who owns my data" must be addressed for NI to fully grasp the Digital Health opportunity. The pandemic displayed the importance of this, with both the UK and Norway discontinuing the initial versions of their contact tracing apps due to legal concerns over privacy. A strong legal framework, guided by input from the populace, will be necessary for NI to maximise the use of its citizens' data in developing digital health solutions.

Ways of Working

Enforced by the pandemic, which has since become a new norm, remote working is just one of a series of changes which continue to transform the working world. These include flexible hours, career changes rather than jobs for life, and the increased use of screens and digital tools.

Digital Health

Increasingly, it has been accepted that a doctor and a patient do not need to be in the same room for healthcare to be delivered. Telehealth consults remain the minority at ~25% amongst UK general practitioner's (GPs), but as high as ~40% for some major US providers like Kaiser Permanente. Medicine will increasingly be delivered by Zoom, MS Teams, and other online services. The utilisation of wearable devices for the identification of patients at risk or for health tracking, will allow for preventative interventions as well the generation of real-world data within clinical trials

Sustainability

Manufacturing

The reuse of power, raw materials, and resources can be applied in LHS, as illustrated by the Danish Kalundborg Network. Novo Nordisk, the Danish pharma giant, is one of 11 public and private partners engaging in this collaborative program to reuse and recycle. In one example, steam generated as a by-product from a power plant is funnelled to Novo Nordisk to heat reactors, the biological runoff of which is transferred to a fertiliser factory. Together, the network saves 635,000 tons of CO2, 3.6 million tons of water, and £19.5m per year. [19]

Medical Devices

Medical devices are facing a sustainability crisis due to the increased usage of single-use disposables, causing higher greenhouse gas emissions and greater economic costs. For example, reusable laryngoscopes, can be more cost-effective than disposables after only five uses. The circular economy presents opportunities to transition from disposables to reusable or remanufactured devices, offering significant economic and sustainability advantages. Stryker are exploring remanufacturing old or disposable devices, adhering to original quality standards, marking a promising stride towards eco-friendly healthcare solutions. AMIC's innovative manufacturing expertise plus academic network, can advise and help organisations enhance their sustainability practices.

In LHS, nearshoring and reshoring are gaining prominence as strategies to enhance supply chain resilience, addressing challenges from international trade, and pandemic repercussions.

Supply Chain Resilience

Although we still live in a globalised world, many organisations have recently recognised the value of locating essential links in their supply chain close to home.

Reshoring and nearshoring are trends achieving greater prominence in recent times. They are phenomena within global supply chains where a company moves some operations to a location that is either in the company's home geography or geographically close. Unlike offshoring, where companies often move operations to far-flung locations to cut costs or access new markets, nearshoring aims to achieve similar cost savings and strategic advantages but within a region that's closer to home.

This strategy has been particularly embraced within the LHS sector to address supply chain challenges. For example, many medical equipment manufacturers are nearshoring in locations such as Mexico, which is close in proximity to the US, particularly the San Diego LHS hub.

NI could become an attractive nearshore location for UK, EU, or even US LHS businesses. It could play a vital role in reshaping global supply chains in a world still grappling with the complex challenges of international trade, geopolitics, and pandemic repercussions.

At the same time, supply chains are becoming increasingly complex and data-driven, leading to new challenges in this field.

Personalised Medicine

The supply chain of "the right medicine, to the right person, at the right time" has yet to be solved by the LHS industries, whose competencies lie with R&D and mass production. An ATMP product often requires harvesting of patient cells in hospital, transport to a facility, production, quality control, and transport back to the hospitalised patient for infusion. Organisations that can solve this intricate, multi-layered process will provide value, likely via applying cold-chain infrastructure knowledge gained from COVID-19 and having adequate cryopreserving and transport capacity.

Manufacturing and Medical Devices

The COVID-19 pandemic created unprecedented shortages, not least in medical devices. Manufacturers were mandated to inform the US FDA on expected supply shortages; although the mandate has expired, voluntary notifications persist in the US and EU, with opportunities for CMOs who can "fill the gap" produced by supply chain shortages.

Societal macrotrends

Long-term shifts in population demographics have already happened, producing a new need for LHS solutions in an aging population.

Aging Population

The World Health Organisation (WHO) observes that by 2050, the number of people aged over 60 will nearly double, and those over 80 will triple. In 2020, those aged over 60 outnumbered children under five, and over 60s will make up 22% of the world by 2050. Although aging is to be celebrated, this brings challenges and opportunities to the LHS sector. [20]

Clinical Trials

Despite our living in an increasingly older world, and older people disproportionately suffering from illness, the elderly are generally not included in clinical trials. An example is COVID-19 vaccines, where only 1.7% of trial participants were older than 75 years, despite this demographic being the first to receive vaccination. [21] As the population increasingly ages, and lifespan increases, clinical trials will either have to begin recruiting the elderly, or accept trial demographics which are not reflective of the population. NI has an opportunity to lead if it can engage its older population in improving their own and everyone's health.

Regenerative Medicine

Regenerative and advanced therapies are generally trialled in and intended for younger patients. Excluding cancer treatments (an age-related disease), the age of a trial patient is typically below 18, as is the case with FDA-approved therapies such as Luxturna (median age of patient in trial 17 years [22]), Skysona (6 years [23]), Vyjuvek (17 years [24]), Zynteglo (13 years [25]), and Zolgensma (4 months [26]). This emerges both from the economics of a once-off treatment in an older person, as well as the fact that many gene therapies are trialled in serious conditions which limit patient lifespans. However, as regenerative medicine costs reduce with mass production, we expect to see new therapies trialled in age-related diseases, and already approved therapies for non age-related diseases expanding into a market of this age group. NI's growing and aging population will increase demand on the HSCTs, with chronic diseases increasing in potential frequency. This will bring to the fore additional clinical and ethical considerations for deployment of these advanced therapies, such as the need for rationing in an aging population, already a contentious issue.

Preventative medicine

The transition towards preventative medicine, fuelled by enhanced biological insights into disease, is an emerging global healthcare trend with significant implications for NI's LHS sector. This shift promises improved health outcomes and the possibility of long-term financial savings. Collaborations between NI's LHS sector and government entities have the potential to boost public awareness and initiate prevention programmes, further solidifying the region's commitment to preventative healthcare.

MedTech and Diagnostics

NI stands out as a leader in advanced personalised diagnostics and biomarker discovery, areas where it has shown considerable excellence. Prominent local companies like Almac Group, with extensive expertise in biomarker discovery through to companion diagnostic partnerships, and Sonrai Analytics, a front-runner in AI driven data analysis, are at the forefront of this innovative wave.

Advanced, costly therapies are driving a need for innovation and affordability; while the rise of home-based healthcare and telemedicine offers personalised, efficient solutions to at least partially address the challenges of rising costs.

More Advanced & Costly Therapies

Recent tendencies in LHS signal the appearance of more costly therapies created to address chronic illnesses with the potential for long-term treatment. These therapies, including biologics and gene therapies, provide inventive solutions and enhanced effectiveness, but the intricacy of their development and state-of-the-art technology contribute to their elevated costs. As a result, healthcare systems and patients encounter difficulties in managing the financial strain of accessing these revolutionary treatments, prompting ongoing debates on how to find a balance between innovation and affordability, whilst ensuring fair access to those in need. This trend holds several consequences for the NI LHS sector.

MedTech

Companies specialising in medical device design have an opportunity to create bespoke devices that assist in the delivery and observation of hyper-expensive therapies. They will need to concentrate on value-based design principles to guarantee affordability and improved patient outcomes.

Personalised Medicine

Innovators in personalised medicine will experience pressure to substantiate the steep prices of their therapies and illustrate their cost-effectiveness, leading them to pursue strategic alliances for reimbursement and enhanced market access. Whilst clinical trials operators will need to modify trial designs to effectively assess hyper-expensive therapies, they must also deal with ethical concerns connected to access.

Healthcare in the home

The trend of healthcare in the home is revolutionising the way medical care is administered, making it more personalised, accessible, and efficient. Telemedicine, virtual care services, home health monitoring devices, and home infusion therapy are just a few examples of how technology is enabling patients to receive medical care without stepping into a traditional healthcare facility. This shift towards home-based care is driven by the need to enhance patient convenience, provide continuous monitoring for chronic conditions, reduce healthcare costs, and leverage the power of digital tools to facilitate remote consultation and treatment.

While NI has shown some engagement with this trend, particularly with the approval of Hospital Services Limited's next-generation Telehealth solution for stroke patients, there is considerable potential for growth in embracing these innovations.

matrix.

Opportunities for NI

In the light of these macro trends, NI should choose opportunities where its strengths are pitched against relative difficulties for other regions, or those where the field is so new that there are ample growth prospects.

Personalised Medicine

We see personalised and regenerative medicine as the most likely sector to be revolutionised by the macro trends of our era. The entire value chain of personalised medicine will be impacted; R&D by AI-driven drug discovery, trials by advanced mobility, manufacturing by robotics and supply chain upheavals, and the reconsideration of who receives therapy in light of customer experience and an aging population.

NI has extensive experience in age-related diseases which are integral to personalised medicine, such as cancer, obesity, cardiovascular disease, and more. Many CoEs associated with the Connected Health and Prosperity Agenda (CHPA) have the requisite skills to advance personalised medicine. These include advanced clinical trial expertise (iREACH), digital technology development (CDHT), advanced data analysis (GII), and Pharmacogenomics (Personalised Medicine Centre). Additionally, established entities like the Precision Medicine Centre and the NI Biobank at QUB are well-positioned to collaborate with these new centres, creating a comprehensive and integrated approach to personalised medicine.

MedTech

The GII and AMIC together have the data handling and manufacturing experience to innovate extensively in NI's MedTech sector – specifically in medical device manufacturing.

AMIC's "Factory of the Future" is designed explicitly to bring cutting-edge innovation to industrial production; especially its digital twinning capacity, which utilises data to simulate, test, and monitor manufacturing improvements.

CDHT has core expertise in MedTech which have been instrumental in the formation of spin-out organisations in this area.

Clinical Trials

NI is a small, well-defined, potential test-bed for MedTech and medicinal solutions. iREACH is well placed to build on prior successess and drive this industry for NI. The increasing digitalisation of healthcare, driven by the IoT, creates an opportunity for cross collaboration with other CoEs, such as GII and the CDHT, which could create a NI offering unique in the world. NI's LHS ecosystem is also enabled by a well-developed support network of LHS service providers, such as contract manufacturers, consultancy services and distribution players etc. This strong service sector further contributes to NI's ability to successfully scale these collaborative interactions, thereby enabling the region to develop as a globally recognised LHS hub.

Digital Health

The CDHT and the Living Lab will capitalise on the digital revolution driven by AI and the IoT. NI is one of the few places in the world with the talent and know-how to not only drive the digital health revolution, but also safeguard it via its unrivalled knowledge of cybersecurity. This is a key opportunity for NI that must be seized.

05

Lessons from International Hubs

Overview of international LHS hubs profiled

Examining international LHS hubs can provide valuable insights for NI into effective incentive strategies, and how they have catalysed growth by leveraging existing strengths.

Identifying relevant global hubs

Rationale for examining other international hubs

Industry hubs, or 'clusters' are a significant lever for helping boost local economies. These clusters often have higher paying jobs, fast-growing businesses, and successful start-ups. The secret to their success lies in a mix of healthy competition, cross-sector collaboration and easy access to skilled workers and the right facilities. They also make it easier for people to share knowledge and manage supply chains effectively.

Methodology

Six global LHS hubs selected by the Matrix LHS panel have been profiled, with an emphasis on regions which have successfully implemented similar funding deals or incentivisation packages for the LHS sector.

Our research, informed by expert consultations within each region, yielded context into success factors and pitfalls experienced as the clusters have grown. Using these international practices as a benchmark, we identify some lessons learned insights to nurture a thriving LHS sector in NI.

Benefits of industry clusters [27]

13.5%	77%	77%
Higher average wage	More high growth firms	More rapidly growing start-ups

Selected hubs

1. Flanders, Belgium
2. Galway, Republic of Ireland
3. Medicon Valley, Denmark-Sweden
4. Newcastle upon Tyne, England
5. San Diego, USA
6. Singapore

Key learnings

Profiles of successful LHS hubs show leveraging adjacent industries, academia-industry collaboration, and attracting foreign investments as key drivers.

Key learnings

Opportunity 1: Capitalise on adjacent industries

Regions such as Flanders, Galway, Singapore, Medicon Valley, and Newcastle have effectively leveraged their established industries like agrifood, manufacturing, and others to drive growth in related sectors. NI can adopt a similar approach to foster the growth of the LHS sector. By engaging professionals and experts from sectors like manufacturing, regtech, cybersecurity, and agrifood, their skills and expertise can be translated into LHS relevant domains. For example, by facilitating cross-industry workshops and collaborations, or setting up a task force that identifies potential overlaps between these sectors and the LHS industry.

Opportunity 2: Balance public and private funding for sustainable growth

International hub ecosystems typically benefit from a combination of public and private funding. As seen in Flanders, Belgium, initial public funding catalysed growth, gradually giving way to a more significant role for private venture funding. Newcastle's ecosystem, in contrast, faces challenges in managing operating costs, highlighting the need for a sustainable funding model, potentially encompassing private funding sources. For NI, a self-sustaining, long-term growth plan could be pivotal. A corporate tax rate, devolved from the UK rate, and brought in line with the RoI's rate, could attract more private funding. Additionally, establishing public-private partnerships, creating favourable regulatory frameworks for start-ups and high growth firms, and promoting NI as an attractive investment destination could further stimulate private sector funding, ensuring the future success of the CoE.

Opportunity 3: Encourage academia-industry collaboration

Co-locating academia and industry in science parks has demonstrated success across various regions. Mandatory industry placements for PhDs, innovation funds involving industry, and cultivating industry partnerships can foster knowledge exchange. While unexpected industry partnerships might emerge organically from such co-location, they can be strategically encouraged by creating open innovation spaces, tenancies (such as at Clinical Translational Research & Innovation Centre (C-TRIC)) and cross-industry networking events. NI could adopt these tactics to boost collaboration and innovation.

Opportunity 4: Strive for recurring FDI investments

Driving growth relies on capitalising on reinvestments from major FDIs. These various profiles show how big pharmaceutical companies have become deeply rooted in the regions and have reinvested multiple times, signalling their confidence and commitment. Singapore, for instance, has strengthened its presence by securing reinvestments. For example, Novartis and Johnson & Johnson initially invested in manufacturing, and later expanded to regional headquarters (HQ). Additionally, companies like Sanofi, Merck, and GSK invested in production and later invested again in vaccines during the COVID-19 pandemic. Galway is another example of recurring investment, where Medtronic and Boston Scientific's initial investments in the 1980s and 1990s led to other sites across the Republic of Ireland.

Flanders, Belgium

Flanders has built on its geographic location and infrastructure to attract pharmaceutical companies looking to export to the world.

Overview

Population of region	~6.6m
# of LHS employees	~21,100
# of LHS companies	~300
Value of sector	£72.5bn in exports in 2021 (increased from £48bn in 2020, due to COVID)
Themes	Vaccines Exports Cell therapy R&D

Overall growth story for the region

Belgium, and Flanders specifically as its sea-bordering region, has built its LHS sector around being a well-connected part of Europe. It takes ~2hrs to travel between any two points in Flanders, which has the world's densest road network. Its roads link to those of the UK, France, Germany, and the Netherlands, and the World Economic Forum ranks its port infrastructure ninth globally, just behind highly coastal hubs like Singapore, Denmark and Hong Kong. This is backed by Brussels Airport, which has a large temperature-controlled pharma warehouse, and was the first airport to receive the "International Air Transport Association's' Excellence in Pharmaceutical Handling" certificate. Flanders has leveraged this to appeal specifically to LHS manufacturers who have complex supply chains, or a need for rapid-transit transport. Pfizer's COVID vaccine must be shipped cold and requires 280 components from 86 suppliers in 19 countries to make, making its needs acutely matched to Flanders' strengths. As such, Pfizer operates its largest manufacturing facility in Puurs, a small town in Flanders located between major cities. [28]

Description of the LHS cluster in the region

Flanders possess both manufacturing and R&D capabilities. Belgium and Flanders rank 2nd in Europe for pharma and biotech patent applications per capita as well as number of (bio)pharma researchers per capita. [29] Pharma investment in Belgium was ~£4.4bn in 2021, the second highest in Europe. Flanders has made efforts to appeal to both R&D and manufacturing industries. 80% of personal income withholding tax for R&D personnel can be applied for by companies, as well as 25% exemptions for night / shift workers. [30]

Ecosystem

Anchor LHS companies

Pfizer's largest production site worldwide is located in the small town of Puurs, with ~3,500 employees. This site, due to receive an additional £10.3bn in investment over the next three years, produced all of the ex-US mRNA COVID vaccines prior to May 2021, ~1.2bn doses / year. Pfizer has encountered a business-friendly environment, with the town even selling it a road in order to better connect its facilities. [31]

Johnson and Johnson have partnered with Legend Biotech to open a production hub for chimeric antigen receptor T-cell therapies intended for patients in Europe, the Middle East and Africa. The rationale for locating the manufacturing of cell therapies in Flanders is similar to that of vaccine production, given the complex supply chain.

GSK employs 9,000 people in vaccines in Belgium, with R&D scientists comprising ~20%. Traditional infectious disease and viral-associated oncology are areas of focus. Belgium hosts 3 vaccine sites for GSK, producing ~770m vaccines / year. [32]

Novartis is also present in Puurs, where 1,500 people work in the world's largest facility for eye drops and viscoelastic manufacturing. The facilities have high-quality standards, with local leadership noting it can export to Japan without requiring the usual additional quality control needed for this.

Companies such as Organon (2,000 employees), Sanofi (900), and Merck (900) also operate manufacturing facilities in the region; [33] all of these sites combined produce a rich ecosystem.

Flanders established a series of dedicated research organisations which focused on answering big questions and producing spin-offs to commercialise them. Public entrepreneurship funding has been directed via industry to grow the sector.

Centres of Excellence

Vlaams Instituut voor Biotechnologie (VIB) was founded by the Flemish government in 1995 to drive biological research. It focuses on all aspects of biotech and operates a total of 9 facilities at 6 campuses across the region.[34] In addition, VIB provides LHS training and coaching. Notably, the VIB Core Facilities offer consulting, all-in services, tech transfer, and use of facilities. This can bring "omics" data or customised antibody production to smaller LHS players. Around a dozen VIB spin-offs have gone on to establish themselves, usually via initiating in a science incubator.

IMEC, another government initiative, concentrates on nanotech and digital healthcare technology. Healthcare applications are widespread, with the centre exploring microchip applications in sequencing and cell therapy production, a strength for Flanders. Its digital health spin-out Bloomlife has produced pregnancy monitoring tech.

Belgium's largest university hospital, **UZ Leuven** gradually relocated all its research services to its Health Sciences Gasthuisberg campus. The Group of Biomedical Sciences draws members from both the hospital departments and the local university **KU Leuven** to produce interdisciplinary research.

Drivers of success

Incubators and accelerators

Flanders hosts several projects in order to nurture developing LHS companies.

Ghent's Zwijnaarde Science Park hosts two incubators. Bioscape is designed to help companies grow within a modular, customisable lab environment. It is located adjacent to VIB, as well as by companies like Bayer. Easily accessible, it offers a conference and learning centre, a business lounge, a front desk service, and other services for start-up companies. **Bio-Accelerator** Gent is another accelerator located close to VIB research buildings. ~10 new start-ups launch in the park every year, which has pilot scale advanced manufacturing facilities. [35]

Bio-incubator Leuven hosts ~25 LHS companies, mostly in the cell therapy space. Cell therapy is a strength of big pharma companies in the region. The incubator works closely with University Hospital Leuven, VIB, IMEC, and the non-profit LHS Research Partners VZW. [36]

The global company Johnson & Johnson has also opened a JLABS incubator in Beerse, where its subsidiary Janssen opened research labs in 1957. Another life sciences hub, San Diego, also hosts a JLABS.

Funding and incentivisation

A combination of public and private funding sources supports the biotech ecosystem in Flanders. **Research Foundation Flanders (FWO)** and **Flanders Innovation & Entrepreneurship (VLAIO)** have key roles in public funding.

FWO funds ~1,000 PhD and ~800 postdoctoral fellowships per year, ~70% of which is in basic, non-applied, research. This generates a talent pool for local life sciences organisations to drawn on. [37]

VLAIO mainly directs its £343m budget to industry, which contracts with academia to carry out research or provide services. Funds are allocated via the industrial partner. A single firm can receive up to £6.9m / year, and 50% coverage of its R&D costs. ~£200m of the budget is indicated for innovation and R&D, with the rest ringfenced for more practical purposes such as partnering, service expansion, hiring consultants to help SME growth, or TETRA, a "practice-based" fund where the focus is specifically on non-R&D intensive companies. [38]

In the last decade or so, private sources – often in the form of venture funding – have come to provide a significant portion of sustained funding for biotech companies in various stages of development. **V-bio-Ventures** has a preferred partner relationship with VIB and has invested in 20 companies with ~£159m under management.[39] **Fund+** is another venture fund with a strong focus on Flanders-based LHS companies, having invested in 22 companies, many overlapping with those backed by V-bio-Ventures. Both funds are founded or led by PhD holders who subsequently diversified into investment management, indicating investors trust relevant experts to make investment decisions.

While not exclusive to Flanders, programs like the **EIC Accelerator** can provide funding for individual start-ups and small companies.

Ecosystems and networks link to the wider Belgium network, but retain their focus on Flanders. Flanders.bio underpins the network, while specialist groups like Flanders Vaccine and Opinno cater to industry sectors and students.

Ecosystem networks

The LHS ecosystem in Belgium involves multiple entities with different roles and responsibilities. The primary entity in the coordination of Flemish biotech is flanders.bio.

flanders.bio is a dedicated network for the LHS sector in Flanders. This non-profit organisation connects biotech companies, research institutes, and government agencies to foster collaborations and support the sector's growth. The various universities and research institutions collaborate with companies and organisations in the private sector, often through collaborations that arise organically. It has a number of projects, including MEDIVA, Opinno, and Flanders Vaccine.

MEDVIA aims to boost collaboration and stimulate healthcare innovations at the crossroads of medical biotech, MedTech and digital technology.

OPINNO is a flanders.bio initiative that unites all five of the region's universities and several colleges. Each year, every institution hosts guest lectures by young professionals in the LHS, as well as a networking coffee event. The idea is to stimulate students to consider an industrial career, as well as to direct them towards skills gaps in Flanders.

Flanders Vaccine exists to stimulate development of vaccine production in Flanders. Although a specialist area of LHS, Flanders holds Pfizer's primary vaccine manufacturing site in Europe, with ~3,500 employees. [31]

Pharma.be is the general association of Belgium and Flanders' pharmaceutical industry.

Essenscia Vlaanderen is the federation for chemicals, plastics and LHS in Flanders, providing network and lobbying.

> "The funds and polices are there to help translate PhDs and post docs into industry. Funding normally stipulates you publish several papers, and ~10% of PhDs have to do a six month industry placement.
>
> *Senior representative, Flanders LHS Cluster*

Galway, Republic of Ireland

Galway's decades long history of MedTech manufacturing has created an ecosystem supporting spin-offs and SMEs. The region is an R&D cluster of excellence, with the University of Galway boasting more European patent applications than any other RoI university in 2022.

Overview

Population of region	85,000
# of LHS employees	15,000 [40]
# of LHS companies	450 companies (nationwide)
Value of sector	£11bn in exports (nation-wide)
Themes	MedTech manufacturing Medtech R&D CGT

Overall growth story for the region

Galway's strengths in MedTech are a generation in the making, with the region attracting major employers such as Medtronic and Boston Scientific in the 1980s and 1990s. Eight of the world's top ten MedTech companies have a presence in Galway. Having built a firm foundation via these global firms, the region has since developed its innovation, spin-out, and business development capacities, resulting in spin-outs entering successful funding rounds. These include Loci (£2.4m), Tympany Medical (£3.1m), and Aurigen Medical (£2.6m). [41, 42, 43] Recently, the area has sought to diversify its industrial base, with the University of Galway developing a GMP-compliant Centre for Cell Manufacturing to drive industrial expertise in personalised medicine therapies.

The overall growth in Galway has caused spillover prosperity, with 3,000 people employed in MedTech in the adjacent counties of Roscommon and Mayo. [40]

Description of the LHS cluster in the region

The Galway LHS cluster is heavily weighted towards MedTech, in contrast to other regions of the RoI which have a greater focus on pharmaceuticals. The development is organic, and complements rather than competes with the rest of the RoI.

Ecosystem

Anchor LHS companies

Medtronic has been established in Galway since 1982, currently employing 3,000 individuals in the region. The company eventually relocated to the RoI, basing its headquarters in Dublin along with two Centre of Excellence R&D sites across the country, for a total of 4,000 employees in the RoI. [44]

Boston Scientific is a long standing, global employer also with operations locally. An initial investment in Galway in 1994 led to two additional sites in other regions, with a total of 6,500 employees across the RoI. [40, 45]

Academic institutions

The University of Galway is one of the RoI's leading MedTech universities, applying for more patents with the European Patent Office in 2022 than any other university. ~25% of RoI patents were in MedTech that year, indicating NUIG is a strong contributor to R&D. 46,47

Atlantic Technological University (ATU) produces around 5,000 graduates annually from its campuses in the west of the RoI, with a focus on supporting local industries such as MedTech. The Technological Universities have been a focus of the government, with a total of €90m dedicated to develop these centres over a three-year period. [48, 49]

Centres of Excellence

BioInnovate is an innovation hub which takes the tried and tested Stanford BioDesign framework and applies it to the needs of the MedTech industry. It is the only centre in Europe to apply the BioDesign methodology, applying best learnings from innovation hubs in Stanford. To date the centre has helped 22 companies raise £25m in funding. It partners with local, national, and international universities as well as major employers.

The University of Galway hosts a large number of CoEs, most of which make a point of interacting with both clinical researchers and industrial partners.

Centres of Excellence (cont.)

The Medical and Engineering Technologies (MET) Gateway is an Irish-government funded applied research centre based in the ATU. The centre offers 3D printing for prototyping, medical imaging, data services (visualisation, storage, analytics), and more to help start-ups access resources in their embryonic phase.

University of Galway's Centre for Cell Manufacturing and the Regenerative Medicine Institute (REMEDI) provide the manufacturing and R&D excellence needed for CGTs. REMEDI hosts 14 research groups, with diverse research themes and disease areas but similar methodologies in regenerative therapies. The Centre for Cell Manufacture provides industrial-grade facilities for scaling these therapies and provides a unique postgraduate course in Cellular Manufacturing to train the personalised medicine workforce. REMEDI also cooperates with the HRB Clinical Research Facility (see below) to enrol patients, often a sticking point for specific and small personalised medicine trials.

The **Health Innovation Hub Ireland (HIHI)** is a national program which aims to connect hospitals and primary care centres with researchers and enterprise. It has three centres based in universities or hospitals in Cork, Dublin, and Galway. It describes its primary role as offering companies the opportunity to do small-scale pilot or clinical validation studies.

University of Galway's CORRIB lab is another research facility focused on a specific area within biotechnology, in this case cardiovascular disease. This CoE combines imaging analysts and cardiologists, and offers support through all phases of clinical trials.

CURAM is a recent CoE, established in 2015 to capitalise on the need for new smart devices in MedTech. It partners with national universities in Dublin, Cork and Limerick, and mainly focuses on product R&D. It partners with the National Standards Authority, in part to ensure future devices will be market ready, and runs both doctoral (MedDevDoc) and postdoctoral (MedTrain+) research via partner institutions.

Galway applies learnings from other regions, with BioInnovate's BioDesign program a notable example.

Centres of Excellence (cont.)

The **Health Research Board Clinical Research Facility** is a joint program between the University of Galway and two local hospitals, Galway University Hospital and Saolta. It offers support to entities hoping to enter into clinical trials, via assistance in study design and analysis, regulatory submission, contract review, pharmacovigilance, and controlled storage. The program also maintains an Advanced Therapies and Cancer Clinical Research Group, intended partially to link to REMEDI to enable personalised medicine trials.

Drivers of success

Applying lessons from other hubs

Galway has taken lessons from other national and international hubs, combining the learnings of other regions with its own expertise. BioInnovate, which utilises the Stanford BioDesign program, has raised £25m for its launched companies. HIHI is an extension of a national program, rather than a local equivalent. This is an efficient and effective method of not only developing local capabilities, but also creating national and international connections.

Support from R&D to the clinic

Crucially, many of Galway's supports to the industry focus on the entire journey from "bench to bedside". One example is the partnering of REMEDI, the Centre for Cell Manufacturing, and the HRB Clinical Research Facility. This creates a ready-made pipeline for companies to travel from university spin-out to an entity not only with the capacity for a clinical trial but with the support to launch it.

Funds

The RoI has created several funds to drive local infrastructure, including:

CURAM investment: CURAM was initially funded by the RoI government specifically to explore innovative medical devices. A re-investment of £40m followed in 2021. [50]

Technological University Transformation Fund: This three-year £79m fund is intended to help Institutes of Technology carry out the necessary changes to become fully fledged Technological Universities, aimed to provide the technical education needed for the LHS industries. [49]

Ecosystem networks

Galway enables a rich ecosystem by linking researchers, industry, clinicians, and governmental organisations together to address common problems. Multiple CoEs are an example of this, not least **CURAM**, and the interlocking trio of **REMEDI,** the **Centre for Cell Manufacturing,** and the **HRB Clinical Research Facility**.

MedTech Rising is also an annual business leaders conference, held by the employers' group the Irish MedTech Association and the state development agencies IDA and Enterprise Ireland. The **MedTech Connect** showcase runs in parallel, and is intended for SMEs to present their technological and business solutions to MedTech stakeholders.

Medicon Valley, Denmark & Sweden

The transnational Medicon Valley built on the established Danish pharmaceutical industry to develop its MedTech and clinical trial sectors. A number of global pharmaceutical companies have invested in excess of £1bn in their Danish production capacities.

Overview

Population of region	~4m
# of LHS employees	~65,500 employees
# of LHS companies	~1,150 companies
Value of sector	£25bn in exports (2021, Denmark and Sweden combined)
Themes	Pharm manufacturing MedTech Clinical trials Research in diabetes, cancer, and reproduction

Overall growth story for the region

Medicon Valley is split between the Danish island of Zealand and Sweden's Skåne region, which were linked by bridge in 2000. The century-old pharmaceutical industry in Zealand created a pool of talented LHS employees, giving start-ups and new industries an ample workforce. The region moved into clinical trials in the 2010s, with the foundation of Trial Nation (Denmark, 2014) and ASCRO (Association of Swedish Contract Research Organisations, Sweden, 2011), which provide single points-of-contact for organisations wishing to carry out trials. Denmark conducts the world's most clinical trials per capita, thanks to Trial Nation facilitating recruitment, access to biobanks, and national registries. NI will be well positioned to offer a similar service once its electronic health record is fully established. [51]

Description of the LHS cluster in the region

The Danish side is characterised by the existence of global pharma companies, which employ half of the 58,000 Danish LHS employees. MedTech is strong in the Swedish side, with 3,100 of the 7,500 LHS employees working in this field. 88% of employees and 60% of Medicon Valley companies are in Denmark. However, given their different sectoral focuses, the two regions complement one another. Danish companies also regularly list on the Swedish stock exchange to access capital, and >20 Danish Chief Executive Officers (CEOs) have crossed the bridge to lead Swedish companies. [51, 52]

Ecosystem

Anchor LHS companies

The crown jewel of Medicon Valley is Novo Nordisk, Denmark's largest pharmaceutical company and a global leader in diabetes care. Novo Nordisk's 2000-2027 investment plan guides for spending >£4.2bn on its Kalundborg site, where more than half of the world's insulin is produced. Over 18,000 Novo Nordisk employees call Medicon Valley home. [52]

Fujifilm Diosynt Biotechnologies, a CMO and development company, purchased a Biogen factory in 2019 and announced in 2020 it would double the size of the facility, for a total investment of £1.4bn. [53]

The pharmaceutical company Lundbeck also operates a production facility here and has ~1,750 employees in the region. Another Danish company, LEO Pharma, is building a £170m facility in Zealand to bolster its production capacity. [51]

The ecosystem has a vibrant start-up culture, with ~40 Danish and ~15 Swedish LHS companies launching every year. [51]

A notable aspect of the region is the activity of non-profit foundations which partially or fully own major Danish pharmaceutical companies, and are willing to invest in "blue sky" research. The Novo Nordisk Foundation has been particularly willing to fund diabetes research, which the region has expertise in.

> “Clinical trials are a sticky point for FDI – once a company gets doctors and scientists interested in its research, that’s a good incentive to double down and open more facilities.
>
> *Senior representative, Medicon Valley LHS Cluster*

Highly collaborative academic centres have provided a wealth of workers and knowledge to feed into the local LHS sector. 40% of companies are or were based in a science park, highlighting the value of these collaborative spaces.

Academic institutions

A total of nine universities with 35,300 students are based in the Denmark/Sweden region. The University of Copenhagen and the Technical University of Denmark are the largest on the Danish side, with Lund University and Malmö University being the largest on the Swedish side. The University of Copenhagen and Lund University are notable research collaborators, with a joint total of over 200 collaborations, with ~80 partners working with both.

Centres of Excellence

The University of Copenhagen has multiple research centres including the Biotech Research and Innovation Centre, which coordinates closely with the Rigshospitalet Finsen Laboratory on cancer research. Their joint spin-out Adcendo ApS is moving to a Phase 1 clinical trial, after a successful fundraising round in April 2023 brought its total financing to £71m. [54]

The Centre for Biopharmaceuticals and Biobarriers in Drug Delivery is a Novo Nordisk Foundation-funded centre exploring drug delivery optimisation, with ample relevance for the surrounding pharmaceutical industry.

Lund University has two key CoEs. The Lund University Diabetes Centre boasts ~30 principal investigators leading research into almost every aspect of diabetes, and offers educational courses aimed at scientists interested in specialising in diabetes. [55]

The Lund University Biomedical Centre is based close to the Medicon Village and Ideon science parks, the Science and Engineering faculties, and Skåne hospital. Any Lund University staff member can apply for lab space.

The Steno Diabetes Centre Copenhagen is Scandinavia’s largest diabetes clinic, historically founded by Novo Nordisk as a charitable hospital. Although open to collaboration, all potential research is directed via a central pathway, with synergistic and patient-orientated research being prioritised for access to patients.

Drivers of success

Science Parks

Science parks are key, with 40% of companies currently or formerly based in one of Medicon Valley’s nine science parks / incubator locations. 2,000 companies and 24,000 employees across life and non-LHS work in a science park. 685,000m2 of real estate is available for companies at relatively low costs. Labs can be rented for ~£910/month, with office space at ~£330/month. [56]

Research focus

The region boasts 14 research institutions and 15,000 research staff, with a total of 11,000 LHS publications in 2021, placing the region 5th in European science clusters. ~1,700 researchers are in oncology, with ~1,000 in diabetes. There is a lack of specialisation with both Zealand and Skåne carrying out research into diabetes and other areas of shared expertise. 28 of the region’s hospitals collaborate in clinical research. [57]

Funding and incentivisation

The Novo Nordisk Foundation provides a wide variety of funding, including Interdisciplinary Synergy Funds of £1.75m for 2-4 collaborating groups, Steno Collaboration Diabetes grants of £1.2m for Steno Diabetes Centre researchers undertaking clinical research with a partner, and various funds for one-off projects, conference attendance, and research. [58]

Since 2015, the EU's Interreg Öresund-Kattegat-Skagerrak has granted just under £41m to 18 joint Danish-Swedish development projects in the LHS. It has also funded the Medicon Valley Alliance to take stock of the local ecosystem and conduct market research among its members. [56]

The Lund University Diabetes Centre also offers £16,000 Innovation funds for projects with commercial potential, with both a joint panel of scientists and industry allocating prize money. [59]

The Innovation Fund Denmark sponsors PhDs and postdocs via its Industrial Researcher program, which explicitly aims to bring academia and industry together.

The Medicon Valley Alliance undertakes research on the ecosystem, provides representation to governments for its members, and acts as a forum to discuss business challenges. It is a key lynchpin in Medicon Valley.

Ecosystem networks

Spanning two countries and several LHS sub-sectors, the ecosystem does not have a single coordinator, but several cross-border organisations which help drive collaboration.

The Medicon Valley Alliance acts as a cluster organisation to represent its fee-paying members, particularly where cross-border elements intersect with LHS research and innovation. For example, the Alliance has previously lobbied to improve conditions for LHS employees regularly commuting between Sweden and Denmark. Annual summits are held to network and focus on priorities for the year ahead. Its >300 member organisations are drawn from across industry, academia, regional and city governments, healthcare providers, and even a language school specialising in inter-cultural communication. [60]

A number of networks within the Alliance focus on special topics, such as oncology, women's health, MedTech, and executive matters, and host their own regular events with information for members.

Healthtech Nordic is a cross-border initiative partnered with Invest in Skåne, Innovation Skåne, a number of science parks and business incubators, and the Norway Health Tech cluster. It has ~130 members in the Medicon Valley. [61]

> "25 years ago, it was rare to see academic industry collaborations. The Innovation Fund Denmark has been key in nurturing these, and what works is clear academia industry agreements on PhD funding and placements.
>
> *Senior representative, Medicon Valley LHS Cluster*

Newcastle upon Tyne, England

Newcastle has undergone a significant transformation in its economy in recent decades, pivoting away from traditional industries and embracing new emerging industries and foreign direct investment; the Biosphere is the beacon of the thriving LHS sector there.

Overview

Population	~825k
# of LHS employees	~8,000
# of LHS companies	~200
Value of sector	The region contributes 33% of the UK'S Pharmaceutical Gross domestic Product (GDP), with a turnover of £10.5 Billion
Themes	Diagnostics Healthy Ageing Oncology Pharma Production Rare Disease

Overall growth story for the region

Once known for shipbuilding and mining, the North of Tyne has diversified its industries, significantly contributing to the UK's highest rate of FDI job creation outside London.

The Northern Powerhouse and Levelling Up agendas, alongside capital injections, have fuelled this transformation. The North of Tyne Combined Authority investment funds have also been credited for attracting FDI and sector growth.

The region now excels in software development and emerging technology, including hosting the UK's National Innovation Centre for Data.

Description of the LHS cluster in the region

The region boasts a vibrant LHS ecosystem with three prominent hospital trusts and collaborative partnerships like Newcastle Health Innovation Partners, an Academic Health Science Centre. Newcastle Helix, a £350 million innovation district, serves as a hub for industry leaders, businesses, and researchers in an internationally recognised cluster.

The Biosphere, located within Newcastle Helix, is a dedicated facility for LHS research, development, and commercialisation. Opened in November 2018, the building's design challenges traditional lab culture, with collaborative areas and modular workspaces.

Ecosystem

Anchor LHS companies

Presently, there is a strong representation of pharmaceutical ingredient manufacturing businesses in the cluster including: Piramal Healthcare UK Ltd, which employs ~575 people, and Pharmaron, which employs around ~people. [62, 63]

Accord Healthcare produces essential medicines for the NHS and employs ~350 people in Newcastle. [64]

Iksuda Therapeutics, a biotechnology company focused on developing next-generation Antibody Drug Conjugates for difficult-to-treat solid tumours, including ovarian, lung, and breast cancers, is an example of an innovative company which has established a presence at The Biosphere.

Academic institutions

Newcastle University has two relevant CoEs:

- The Centre for Biomedical Engineering, which specialises in diagnostics, clinical imaging, medical devices, tissue engineering, and regenerative medicine.
- The Centre for Cybersecurity and Resilience, which focuses on protecting medical systems and ensuring privacy for related data.

Northumbria University specialises in microbial biotechnology and collaborates with several industrial partners, including Procter and Gamble, the Royal Air Force, and Johnson

Matthey. They have received over £11.6 million in funding for this area. [65]

Centres of Excellence

Newcastle's LHS CoEs emphasise R&D in key areas, including ageing, data, rare diseases, genetics, and fertility treatment. The UK Government and Newcastle University provide substantial backing and investment, fostering the creation and expansion of these diverse centres.

A common theme across many of the LHS CoEs in Newcastle is the establishment of a clear niche (e.g. Aging, Fertility) and a strong emphasis on innovation.

Centres of Excellence (Cont.)

International Centre for Life: Established in 2000, leading in genetics and fertility treatment, including first three-parent IVF treatment.

National Innovation Centre for Ageing: Initial investment from UK Government and Newcastle University, commercialises products and services for better, longer lives

National Innovation Centre for Data: Created in 2019, £30 million in funding, works on opportunities from digital data.

Newcastle Centre for Rare Disease: Launched in 2020, supports various stakeholders in improving lives of people with rare diseases.

NIHR Innovation Observatory: Horizon scanning facility at Newcastle University, drives innovation in healthcare technologies.

North-East Innovation Lab: Evaluates and validates new products, started with COVID-19 diagnostics, expanded to other health threats like sepsis and cancers

Drivers of success

Funding and incentivisation

This funding environment around Newcastle is diverse and supportive, with various funding sources, incentives, and collaborations aimed at attracting and assisting businesses investing in the North-East region.

Enterprise Zones: North of Tyne has tax breaks and government support through Enterprise Zones, with benefits like business rate discounts (up to 100%) and enhanced capital allowances (up to 100% for eligible businesses making large investments in plant and machinery within the Enterprise Zone). [66]

Invest Newcastle: Invest Newcastle is part of Newcastle Gateshead Initiative (NGI) and is the inward investment agency for Newcastle and Gateshead. Its mandate is to attract companies to invest in the North-East. Its services include market intelligence, site selection, funding and finance advice, and assistance with regulatory and legal requirements.

North of Tyne Inward Investment Fund: This fund provides ~£10million to support to businesses looking to invest in Newcastle, North Tyneside and Northumberland. It can contribute up to 10% of capital costs, and issue grants of between £100,000 to £1million. [67]

North-East Local Enterprise Partnership Inward Investment Grant: Supporting major new investments into the North- East region. Grants available between £1million-£5million depending on project. [66] It also provides supporting capital expenditure in the setting up of the new operation. The Local Enterprise Partnerships have been a key vehicle for releasing funds related to the UK Government's 'Northern Powerhouse' vision, which aims to create economic prosperity in the North of England on a par with London and the South East.

North-East Funds: £120m investment programme available to SMEs across Durham, Northumberland and Tyne and Wear. [67] It is funded by the European Investment Bank (it was confirmed during the period Article 50 was triggered). Various fund types are available: Venture, Innovation, Development Capital, Growth Capital & Small Loan. It is administered by a consortium of fund managers, including Maven Capital Partners and FW Capital.

City and Growth Deals: The North-East region has received the least support from the UK government's Levelling Up Fund, according to a February 2023 report. The report noted there were 11 successful bids in the North-East that accounted for just 5% of the total grants awarded.

The neighbouring North West region, meanwhile, saw the greatest amount of investment from the programme, with 27 successful bids. [68] Nevertheless, the Biosphere at Newcastle Helix was part funded by the North-East Local Growth Fund (along with the England European Regional Development fund as part of the European Structural And Investment Funds Growth Programme).

Despite multiple funding sources, a Newcastle LHS ecosystem representative expressed concern about financial support beyond initial capital expenditure. They suggested sustainable models for covering operational costs and long-term commitments to ensure success, but admitted that a clear idea of how such sustainability will manifest has not yet been expressed. The representative said that transitioning to private funding is necessary yet risky, and proposed having milestone-based private financing arrangements as a potentially effective solution.

It is noteworthy that the NHS Trusts in the region actively collaborate with the broader ecosystem to propel innovation and medical research advancements.

Ecosystem networks

Collaboration in the Newcastle health and LHS sector is a prominent feature of the region's healthcare landscape. Various ecosystem players, including leading NHS trusts, universities, and industry partners, are working together to promote medical research and improve healthcare outcomes.

Newcastle Health Innovation Partners unites the region's research, NHS, and city partners to address health inequalities and medical needs in the North-East and North Cumbria.

Newcastle Joint Research Office is the mechanism by which Newcastle University collaborates with Newcastle Hospital Trust, enabling industry, researchers, and clinicians to conduct advanced medical research. This has contributed to the co-hosting of the Northern Alliance Advanced Therapy Treatment Centre, which aims to increase patient access to cell and gene therapies.

The Northern Health Science Alliance (NHSA) is a partnership between leading NHS trusts, universities, and Academic Health Science Networks in northern England, working together in the LHS sector.

The NIHR Newcastle In-Vitro Diagnostics Co-operative, part of the NIHR MedTech and IVD Co-operative (MIC) network, generates evidence to demonstrate the potential value of new diagnostic tests.

> “Any aspiring LHS cluster must cultivate a distinctive identity and vision that definitively sets it apart from all others; firstly within the same economy and secondly even globally. Newcastle is doing a tremendous job at defining and amplifying its niches.
>
> *Senior representative, Newcastle LHS Cluster*

San Diego, USA

The world's fastest growing biotech hub has a vibrant start-up culture, born out of exemplary R&D at its universities and private research institutions and fuelled by venture capital firms.

Overview

Population	~1.75m
# of LHS employees	~71,000
# of LHS companies	~1,800
Value of sector	Direct output estimated at £40.5bn in 2022
Themes	R&D Biotech Innovation Medical Devices

Overall growth story for the region

San Diego, occasionally referred to as "Biotech Beach", is the world's third-largest biotech hub behind Boston and the Bay Area. The area has attracted the world's top LHS talent in part drawn by the climate and high wages. The region's growth came from a wave of entrepreneurs in the 1970s, many of whom continued their activities even after an initial big pharma buyout.

Description of the LHS cluster in the region

The cluster has a reasonable level of diversification, with ~15% of the workforce in MedTech, ~15% in Biopharma, and the remaining numbers mostly in research, manufacturing, or biotech. 4,600 employees are in IVD manufacturing alone, which grew by 14% in 2021 to 2022. ~10,000 work in genomics, with Illumina, the world's premier genomic company a prominent employer. [69, 70, 71]

Ecosystem

Anchor LHS companies

Eli Lilly acquired San Diego's first homegrown biotech, Hybritech, in 1986, and has made several local acquisitions since. It currently employs several hundred researchers in the Lilly Biotechnology Centre, a state-of-the-art facility with cloud-controlled robotic labs, which received a £72m expansion in 2017. [72]

Pfizer owns a 25-acre campus in La Jolla, close to most of the research CoEs in San Diego. The centre focuses primarily on oncology and vaccine R&D, with multiple commercialised products including Inlyta and Ibrance (£800m and £4bn in sales in 2022, respectively). [73]

Genentech announced a £360m expansion of its Oceanside campus north of San Diego in 2023 in order to manufacture biologics, stating the "world-class biotech talent" in the area was key in its decision. [74]

A large number of other global firms including Johnson & Johnson, GlaxoSmithKline, Takeda and Thermo Fisher Scientific are active in the region. San Diego is also the hometown of Illumina.

Academic institutions

San Diego county graduates >7,000 Science, Technology, Engineering and Mathematics (STEM) students per year, producing a large workforce for the region, and employs 34,000 workers in colleges, universities, and professional schools. [75]

UC San Diego is one of the enablers of research and innovation in the region, and collaborates closely with the non-profit and private institutes in the area, as well as with pharma companies such as Pfizer.

> "The three key ingredients to fostering innovation are academia, start-ups, and capital. Transferring IP out of academia and into the private sector is key. For that to work, universities need to show their researchers they will have a legacy and a stake in whatever comes out.
>
> *Senior representative, California Life Science Association*

Numerous non-profit private research institutions have attracted the interest of industry and venture capital, who responded by funding and investing in start-ups and spin-outs from these centres.

Centres of Excellence

San Diego is notable for the presence of non-profit, private research institutions which constitute many of the CoEs in the region. Many are based in the same part of the county, Torrey Pines.

Scripps Research is the largest private non-profit LHS research institute in the US, with more than 170 laboratories employing 2,100 scientists, students, and other staff. A dedicated Office of Technology Development assists with assessing patentability, commercial prospects, and external partnerships. 50 spin-outs have been launched since 1980. [76]

The La Jolla Institute for Immunology focuses on immunology and immune system diseases, employing ~800 employees. [77] During the pandemic, the Institute became home to the Coronavirus Immunotherapy Consortium, a research collaboration to test antibodies against the novel virus.

The Sanford Burnham Prebys Medical Discovery Institute is another non-profit research centre with broad interests in oncology, neurodegeneration, stem cell research, drug discovery technologies, and other diseases. ~10% of its revenue is from biopharma partnerships, with another ~10% from licensing.

A number of key centres are within UC San Diego, including the **UC San Diego's Movement Disorder Centre;** recognised by the National Parkinson Foundation as among the world's leading centres for Parkinson's research and care. The centre actively promotes trials and physician education to better the local ecosystem.

The UC San Diego's Moores Cancer Centre is among the US's top cancer treatment centres, and is enrolling in >260 clinical trials as of 2023. [78] It also provides education from the undergraduate to postdoc level, even running several high-school programs.

Several more bespoke centres exist, including **The Scripps Institution of Oceanography** which includes labs exploring marine-derived drugs and marine-organism biosynthesis methods. The global genomics company Illumina has provided it with ~£1m of genomics and lab automation technology to accelerate its research. [77]

Drivers of success

Industry acquisitions

The first and most famous local acquisition was of Hybritech by Eli Lilly, for £320m in 1986. This was followed up by the purchase of Applied Molecular Evolution in 2003 for £320m, which later became the core of the Lilly Biotechnology Centre, and SGX Pharmaceuticals in 2008 for £50m. Biocom, a local LHS advocacy group, suggests that up to 150 San Diego companies went on to be invested in, led by, or launched by Hybritech leadership who exited the company after the 1986 acquisition. [79, 80] In 2021, venture capitalists invested £4bn in San Diego LHS companies. [81]

Life sciences real estate

San Diego's LHS community have stated that water and utility usage, zoning laws for construction, and permit approvals are all concerns which slow industry growth. Biocom California, the state's largest LHS lobbying group, was founded in 1995 in response to water shortages in San Diego. The city's 2023 LHS Industry Pilot Program is designed to speed up the building permit process by facilitating project set up, inspections, and occupancy, for new and existing LHS projects. Each applicant will receive a project manager and reviewers with LHS sector knowledge, to expedite approvals.

Funding and incentivisation

National Institute of Health: Numerous private institutes bid for public National Institutes of Health (NIH) funding, with Scripps Research (£16m), La Jolla (£11m), the Salk Institute (£49m) and Sanford Burnham Prebys (£41m) all securing funding in 2021. Total NIH funding to the region was £880m in 2021. [82]

Venture Capital funding: Public sector financing was significant, but venture capitalists invested £4bn in LHS firms in 2021 alone. San Diego captured 13% of all US LHS investment that year. [83]

San Diego's LHS ecosystem is characterised by a strong emphasis on relationships, networking, and several state-wide organisations which advocate for infrastructure, tax policies, and more efficient land use.

Ecosystem networks

Biocom California is the largest non-profit advocate for California's LHS sector. With >1,400 members across the state, Biocom advocates for policy, connects people and capital, and acts as a go-between for member and suppliers via its Biocom Concierge service, which includes everything from human resources (HR) services and lab rental to hotel room booking. [84] Members can access professional development courses, and Biocom particularly features its Capital Partnering programs, where it will facilitate one to one discussions between investors and start-ups. Biocom even operates an office in Tokyo, a location of deep LHS expertise.

The California Life Sciences Association fulfils a similar role as a state-wide networking and advocacy association, also including a supplier network.

The San Diego Biotechnology Network was founded in September of 2008, addressing the need for more high quality, face to face networking among LHS professionals in the greater San Diego area. The organisation keeps listings of various services and serves as a job seeker / advertiser network.

In 2012 the global firm Johnson & Johnson opened its first JLABS in San Diego, close to the Torrey Pines Mesa hotbed of non-profit CoEs. Thirteen **JLABS** are around the world, providing companies with a space to network with Johnson & Johnson experts, utilise cutting-edge lab equipment, access funding, and upskill. ~40 companies are currently in residence in JLABS San Diego, with 140 alumni companies in the Johnson & Johnson network. [85]

> "One voice and one place to go is important, especially in LHS. It's an industry heavily skewed towards relationships and their interoperability. In a good ecosystem, everyone you run into knows five of the same people you do.
>
> *Senior representative, California Life Science Association*

Singapore

Singapore drew on its educated population and ease of doing business to attract pharmaceutical manufacturing to the island in the 1980s. The Biopolis research park and collaboration with foreign universities supports innovation in the region.

Overview

Population	~5.5m
# of LHS employees	~37,000
# of LHS companies	~380 MedTech
Value of sector	~£20bn output in 2021 Pharma manufacturing alone contributes ~4% of GDP
Themes	Vaccines Biopharmaceuticals R&D Clinical research Corporate headquarters

Overall growth story for the region

Singapore's LHS industry evolved from a low base in the 1980s by actively targeting FDI investment. Industrial planners sought to attract pharmaceutical manufacturing interest, eventually diversifying into biopharma R&D in the 2000s and MedTech from 2012 onwards. This culminated in the opening of the Biopolis research park in 2003, which has since completed six expansions.

The final stage of industry development is clinical research, where the country aims to draw on its small size and high population hospital coverage to efficiently carry out clinical trials, focusing on disorders common in the local population both to increase national health and as the "easiest win".

Description of the LHS cluster in the region

The Singaporean LHS cluster is comprised of a mixture of manufacturing, R&D, and corporate roles. Several companies, including GSK, Novartis, and Merck, operate multiple facilities across the island. Singapore's university-industry R&D collaboration is ranked 7th in the world, and it closely encourages health system-research partnerships, with hospitals hosting university research units. SingHealth, the regions Health Service, has experimented with mandating hospitals to allow physicians to carry out research, notably in the KK Women and Children's hospital. [86]

Ecosystem

Anchor LHS companies

The formation of the Singapore Pharmaceutical Manufacturer's Council in 1986 coincides with Novartis locating to the city-state, where it now operates one of the largest biologics facilities in Asia with >1,000 employees. Novartis were actively courted for investment, with visits to its Swiss HQ prior to the opening of Biopolis. [87]

The Singapore Science Park is home to the regional HQ of Johnson & Johnson (1,400 employees in corporate and product design roles), GSK (1,500 employees in corporate and vaccine manufacturing roles), and several other companies. [88, 89]

Singapore capitalised on the COVID-19 pandemic to attract four new vaccine manufacturers and ~450 new roles to the island nation, including BioNTech, Sanofi, and Merck, many of whom had some presence already. [90]

Academic institutions

Singapore's decision to develop a LHS industry was in part based on its highly educated population and education infrastructure, which gave it a competitive edge against other regions. Several universities actively collaborate with international peers, such as Nanyang Technological University (partnered with Imperial College London, King's College London) and the National University of Singapore, (NUS). NUS's School of Medicine collaboration with Duke University has been key in increasing Singapore's biological R&D and innovation capabilities, via its medical doctor-PhD joint degree.

Centres of Excellence

The Institute of Molecular and Cell Biology is a leading institute based at Biopolis; formerly a division of NUS, it is now an autonomous unit carrying out cutting-edge research in diabetes, cancer, and cell therapies.

The Bioprocessing Technology Institute was established in 1990 to drive efficiencies in manufacturing. It has particular expertise in the emerging area of cell and gene therapy (CGT) and out licenses in-house and partner-developed methods to scale production.

The willingness of research institutes to collaborate with each other and with industry is a stand-out feature of the LHS ecosystem in Singapore.

Centres of Excellence (cont.)

Singapore opened five Research CoEs in 2007, which are intended to attract world-class academics to produce new research. Although each is associated with a university, they are autonomous and have their own scientific advisory boards. Three relate to LHS.

Cancer Science Institute of Singapore: Equipped with genomics and proteomics capabilities, the centre actively collaborates with world-class cancer peers in Sweden, the US, Israel, France, and Japan. Some of its drug discoveries have advanced to the clinical trial stage, partnering with small biotechs such as Monopar Therapeutics.

Singapore Centre for Environmental Life Sciences Engineering: A research institute with specialities in microbiology, biofilms, and associated molecules. The centre collaborates with industry partners as diverse as ExxonMobil (oil & gas), L'Oreal (cosmetics and dermatology), UWT (water treatment), and several food tech companies.

Mechanobiology Institute: Within NUS, this institute carries out research into cellular mechanics with applications in heart failure, disease modelling, and plant-based alternatives to meat. On-site facilities include microscopy, nanomanufacturing, protein cloning, and computational facilities to process microscopy data.

Additionally, the **National University Health System** operates several hospitals, and six CoE.

The **Centre for Innovation in Healthcare** allows companies to test products in a live ward and provides assessment prior to product launch, stress-testing potential innovations.

matrix.

Drivers of success

Business friendliness

Singapore is ranked 2nd in the world for ease of doing business, and is notable for its high stability, legal framework that protects investors, and close links to the wider Asia Pacific region. [91] It is the only small nation which is part of the International Medical Device Regulators Forum, which aims to harmonise international medical device regulations.

Government willingness to collaborate

The Agency for Science, Technology and Research (A*STAR) has long standing collaborations on infectious disease treatments with companies like Roche and Novartis. It applied this expertise during the COVID-19 pandemic to produce a rapid COVID test, which was distributed to nearby countries. A*STAR has also engaged with the NUS-Duke School of Medicine to develop ETC-159, the first publicly funded discovery of an anti-cancer drug in Singapore. It is currently in human trials.

Top talent attraction

During the 1980s in the initial pharmaceutical boom, and again in the R&D surge of the 2000s, Singapore head-hunted top academic and industry professionals for key roles within major universities, CoE, and for policy advice. This translated into talent migration at all seniority levels. The Institute of Molecular and Cell Biology, for example, has trained 250 PhD students, but recruited over 800 international PhD holders. Today, ~35% of the Singaporean population are immigrants, mostly in high-skill roles, while the country globally ranks 2nd for talent competitiveness. [92]

In 2014, the government took an active role in skills development, developing a roadmap with industry groups to assess upcoming manufacturing skills needs and solutions.

Funds

Singapore actively invests to drive biomedical innovation, along with introducing tax incentives for venture capital and MNCs.

Bio*One Capital: This investment fund was established to finance the LHS industry in Singapore. A notable investment was in A-Bio, a government owned contract manufacturer based at Tuas park. The company quickly weaned itself from government funding, with GSK and Novo Nordisk acquired as customers.

SEEDS Capital: Enterprise Singapore's investment arm has actively invested in the MedTech space on a case-by-case basis, investing ~£55m since 2014. [93]

Singapore succeeded in uniting the "triple helix" of LHS; government, industry, and academia via physically co-locating stakeholders as close as possible to one another.

Ecosystem networks

Singapore's ecosystem networks are physically represented by three key sites; the Biopolis biomedical research cluster, the manufacturing hub at Tuas Biomedical Park, and the Tukang Innovation Park MedTech Hub.

Biopolis is located close to the NUS, and hosts 11 major biomedical research entities, including the Institute of Molecular and Cell Biology and the Bioprocessing Technology Institute. A*STAR, Bio*One Capital, and the Bioethics Advisory Board are also located in the park, along with ~50 private companies including Novartis. [94]

The MedTech Manufacturing Alliance is a close collaboration between SMEs, MNCs, A*STAR, and several education institutes. It operates under a "pyramid" approach, where large stakeholders (mostly MNCs) agree on common problems. These are communicated to industry service providers and SMEs, which collaborate with A*STAR to produce solutions.

HealthTEC.SG is a platform for industry-academia collaborations, mainly focused on spin-outs in the health technology space. It awards seed funding to academics, mainly in the wearable device space.

> "Our domestic market is very small, so to win we had to play at the global level. We had to choose industries where Singapore could credibly supply the world's needs.
>
> *Senior representative, Singapore Economic Development Board*

06

Driving the Next Stage of Focused Growth

Mapping centres to NI's LHS strengths

Each of the region's CoEs is ready to engage with your industry, academic institution, or public sector body, to further build on what makes Clinical Trials, MedTech and Diagnostics, Personalised Medicine, and Digital Health four of NI's strengths.

	MedTech and Diagnostics	Digital Health	Personalised Medicine	Therapeutics Aspirational	Clinical Trials Aspirational
Belfast Region					
iREACH	◑	◑	◕	◕	●
Global Innovation Institute	◔	◕	◑	◑	◑
Centre for Digital Healthcare Technology	◕	●	◔	◕	◕
Advanced Manufacturing Innovation Centre	◕	○	◔	◑	○
Precision Medicine Centre	◑	○	●	●	◑
Derry & Strabane					
School of Medicine, UU	◕	◕	●	◕	◕
Clinical Translational Research and Innovation Centre	◑	◑	◑	◕	●
Causeway Coast & Glens					
CFDD	◑	◑	◕	◕	●
Foodovation Centre	◑	◑	○	◔	◔

Legend

C&GD CoE	● Highly relevant	◑ Moderately relevant	○ Less relevant
Existing CoE	The level of relevance reflects the views of consultees for this report		

In addition to the LHS-focused CoEs, the Global Innovation Institute and Advanced Manufacturing Innovation Centre, which are the cross-industry CoEs most strongly orientated towards LHS, have been profiled.

Note: The above information reflects aspects of the CGDs which are considered relevant to the LHS ecosystem; it may not be exhaustive. Further details are required to fully evaluate the relationship of Causeway Coast and Glens deal to CoE's.
Note: The CGDs continue to evolve at the time of writing (Nov. 2023). This report represents public domain information from a snapshot in time. The deals are developing rapidly with refined foci, new initiatives, increased coordination, and enhanced private sector engagement likely to have manifested by the time of reading.
Note: QUB and UU both have additional LHS CoEs (for example, The Patrick G Johnston Centre of Cancer Research and the Centre for Diabetes respectively), which provide LHS expertise across the ecosystem beyond the CGD CoEs.

MedTech and Diagnostics

The NI Windsor Framework granting unique dual EU-UK market access for medical devices, coupled with a legacy of success in diagnostics, positions NI for future growth in this area.

Market Context

Recent developments in the UK and Europe

Before the UK's EU Exit, regulatory harmony enabled European manufacturers to sell CE-marked devices in the UK. Post-EU exit, CE-marked devices can continue to be placed on the UK market until the UK Conformity Assessment (UKCA) mark is implemented within the next few years.

NI has gained a unique global advantage as it retains unfettered access for medical devices to both the UK and EU markets, with the continued use of CE marking in the region. This should be leveraged to reassure manufacturers and position NI as a gateway for dual market access.

Additionally, the COVID-19 pandemic has highlighted the value of diagnostics and MedTech, likely driving sustained market demand.

The opportunity for NI

Northern Ireland's present strengths

NI's homegrown successes are in diagnostics, with Almac and Randox presenting as two players who have grown to a global scale. NI also has strength in MedTech, with >2,500 employees across the digital, IVD, and general MedTech sub-sectors, and strong track records of commercialisation from both UU and QUB. [95] NI is also supported by an established ecosystem of LHS wrap around support services for MedTech and diagnostics.

The Windsor Framework for NI creates a unique opportunity; NI will possess dual market access to both the EU and UK MedTech markets, a globally unique position. Consultees noted that while some aspects of the Framework still require clarification, this USP is likely to emerge at the fore of the region's value proposition.

> "IVD innovation is very strong, but could be even more successful with the right support to commercialise.
>
> *Matrix Steering Committee consultee*

The City and Growth Deals

How the Deals build on NI's strength in this area

The BRCD's CDHT Centre aims to unite computing, engineering, and biotech strengths to boost innovation. Its Living Lab at the Royal Victoria Hospital is piloting work in cardiology, to later expand to other chronic conditions. As it does so, relevant MedTech companies should be engaged with to capitalise on the opportunity.

iREACH also has the potential to accelerate MedTech prototypes' journeys into the clinic and should explore this area with assistance from industry partners.

AMIC's expertise in advanced manufacturing could be applied in Diagnostics and MedTech, both in process improvement and advanced composite experimentation.

Finally, some of the skills funding of the CGDs could be applied to LHS, particularly to train regulatory specialists who can capitalise on the Windsor Framework.

What's required to build on the opportunity

Networks

MedTech could be further built by increasing investment, and local interactions between players, as well as exploring collaborations with nearby hubs such as Galway. An example of efforts in this area is HIRANI's role in engaging RoI and UK clusters for specific

projects supporting the Nutrition Innovation Centre for Food and Health (NICHE) at UU. Consultees suggested a dedicated MedTech leader could drive enhanced cross-talk with the broader LHS field, especially digital. Digital MedTech is expected to grow at 12% per annum globally, compared to 6% for MedTech and 6% for Diagnostics. [96]

Dedicated roadmap

Our consultees noted that an industry roadmap could be a valuable tool. This would encompass general and practical advice to circumvent regulatory challenges and alert industry to the benefits of the Windsor Framework giving NI unique access to the UK and EU. It would also list resources and networks to engage in, with clear descriptions of the services offered by the various CoEs. Ideally, the map would offer key pointers on engaging with major buyers such as the HSCTs, NHS, and HSE, which is a necessary step to secure industry buy-in.

Personalised Medicine

NI's pre-existing strengths in personalised medicine from industry and QUB's Precision Medicine Centre will be further bolstered by the CGDs, which will provide a Personalised Medicine Centre. A unified, defined area of expertise could significantly amplify NI's appeal to local and international industry.

Market Context

Recent developments in the UK

The UK holds ~5% of the ~£46bn global personalised medicine market, which is a steadily growing area. [97] Adoption of personalised medicine therapies is also building within the UK. As of 2022, 10 ATMPs were NHS-available in England/Wales, with 44 Phase 3 clinical trials underway. [98] The NI personalised medicine market for predictive and prognostic biomarkers is driven by industry players (e.g. Almac, Randox) and QUB's Precision Medicine Centre.

The opportunity for NI

NI has deep research expertise in several areas, including oncology. Even prior to the CGDs, QUB's Precision Medicine Centre exemplified this expertise in combining pathology and genomics. It also hosts the NI Biobank of patient blood and tissue samples which undertakes analysis of biospecimens, a valuable research asset for NI within discovery and delivery of personalised medicine tests. NI's stable, relatively homogenous population of 1.9m people, coupled with EHR and social data via the trusts, is a powerful personalised medicine resource.

As a key point to consider, biomarkers may be "druggable", and useful to target with medicines, or may have prognostic value and serve as diagnostic markers. Both of these areas, but particularly diagnostics, play to NI's industry strengths. A holistic personalised medicine offering will require an industry-led, research-backed approach to consolidate NI's expertise and strength. From a clinical trial perspective, the higher tech needs of personalised medicine makes the UK and NI an attractive location to run these trials, as opposed to more cost-competitive but less developed regions around the world.

> "This is a truly enormous area of medicine and there's enough for everyone to do.
>
> *Health and Social Trusts consultee*

The City and Growth Deals

How the Deals build on NI's strength in this area

The Personalised Medicine Centre in Derry / Londonderry, which is within the new School of Medicine, will produce both the space and the clinical talent needed to realise NI's personalised medicine potential. The deep "omics" experience will be key in discovering new biomarkers, and both the east and west of NI will now have a personalised medicine research centre.

Similarly, iREACH will act in some respects as a Belfast-based counterpart to C-TRIC, the Clinical Translational Research and Innovation Centre based at the Western Trust's Altnagelvin hospital.

National clinical trial coverage will help increase patient numbers, especially important in personalised medicine where interventions are often in small sub-populations. Close links to the teaching hospitals of Altnagelvin and Belfast City will also be vital.

What's required to build on the opportunity

Unified and defined approach

Consultees wanted to see a clear expression of what disease areas and projects all of NI's academic centres would focus on, which could be communicated to industry. This way, these two key groups of stakeholders would be aligned on initiatives, and industry could communicate its needs back to academia. This would also enable NI to better communicate to international investors where its strengths are. A steering group was suggested as one way of enacting this.

Enhanced supply chain and capabilities

Advanced therapies have complex supply chains often necessitating interactions between hospitals, manufacturing sites, and transporters who can guarantee sterile, cold chain transport. As a small, well-connected region, NI could be an ideal hub for advanced therapies. Wales was noted by consultees as a peer region with learnings for NI as it builds its CGT infrastructure.

Maximised data use

Stakeholders noted the high-value of the Honest Broker Service, which provides anonymous patient records and a legal framework for researchers. A guideline document for Personalised Medicine researchers and companies would further drive use of this valuable resource.

Digital Health

NI's institutions are capturing a broad array of healthcare data, and the introduction of EHRs will further enrich the data ecosystem. Applying the expertise of the CoEs will help capitalise on the opportunity.

Market Context

Recent developments in the UK

The UK's Digital Health market stands at ~£3.3bn, with an expected growth of ~9%.[99] Increases in smartphone use, healthcare data capture, telemedicine and internet connectivity are driving global Digital Health growth. High growth has driven a skills supply crunch, with UK-wide statistics showing ~46% of businesses surveyed struggled to fill data roles during 2019-21. [100]

The opportunity for NI

Northern Ireland's present strengths

NI has over forty companies operating in the software and digital health space, including B-Secur, Neurovalens, and QUB spin-outs Analytics Engines and Kainos, the latter with a market valuation of >£1bn. There is opportunity for NI's strengths in data and software focused sectors like cybersecurity and fintech to further build out the digital health ecosystem.

The Department of Health has a dedicated digital unit, Digital Health and Care NI, which has outlined a number of applicable strategies to drive research and innovation, better use of data, and digital integration.

Other partners have also gathered extensive data. NI's Ambulance Service presents as an institution with NI-wide coverage and access to pre-hospital and community data, which is being linked to data from other trusts. Greater use of this unique resource could create a set of holistic health data, spanning the pre-hospital, hospital, and aftercare stages of the patient journey.

> From an industry view the Living Lab looks very interesting. Anything to get patients out of hospital using virtual wards, wearable tech, anything innovative. NI will need its data handling and cybersecurity capabilities for this.
>
> *LHS sector consultee*

> Combining the digital sector and the traditional LHS ecosystem would create an advanced, unique, market offering.
>
> *LHS sector consultee*

The GII's expertise in data analytics aids the digital health ecosystem, with key opportunities to further drive engagement with tech centres, assist growth in specialised roles, and assist Digital Health SMEs in NI to scale to self-sufficiency.

The City and Growth Deals

How the Deals build on NI's strength in this area

The GII has several highly relevant centres including the GII's Centre for Data Science and Scalable Computing (DSSC). Its expertise in data analytics is likely to be crucial in growing the digital health ecosystem. The Living Lab at UU's

CDHT centre will initially trial health solutions in cardiology, and provides a potential test ground for digital health such as wearable tech.

What's required to build on the opportunity

Workforce availability and upskilling

Industry consultees stated that although NI is usually cost-competitive, data scientists, software engineers, cyber-security specialists and similar roles are in high demand. Although increased skills funding would be welcome, consultees noted the highly technical nature of digital health means companies may have relatively unique skills needs. Coupled with their low training requirements (typically <5 roles/per year), this means flexibility in upskilling initiatives, potentially via engaging with the GII and other CoEs to maximise learning opportunities, would be very welcome.

Seed capital funding arrangements

Digital Health SMEs noted that there can be a "funding trap" where a company is too large to receive start-up funding from public bodies but too small to be self-sufficient. Given the long development time of digital health tech, this can strand start-ups in an economically unviable situation. Flexibility by public funders, or availability of capital (either within NI or by fundraising abroad) will help SMEs escape the trap. CoEs can also take a key role here by sharing their knowledge and expertise and providing use of their capital facilities, helping SMEs progress from small-scale start-ups to self-sufficient entities.

Aspirational: Clinical Trials

NI has the potential to become a leading force in the field of clinical trials, with an ideal infrastructure and a strong network of supporting companies.

Market Context

> We have a solid foundation in terms of the supporting value chain, with a strong opportunity to further increase clinical trial delivery.
>
> *MedTech sector consultee*

> Our strength lies in the network of approximately 20 companies that contribute different aspects of support to clinical trials, including areas like drug manufacturing and biomarker analysis. Capitalising on these strengths with further management and delivery of these trials will deliver huge value.
>
> *Government sector consultee*

> NI should be building capability for clinical trials management even further; it interlocks with our other operational strengths. There's a huge opportunity here.
>
> *MedTech sector consultee*

> NI has the ideal scenario for clinical trials: a ring fenced HSCTs system. We're nearly there and with the right push, NI could be the ultimate clinical trial machine.
>
> *Digital Health sector consultee*

With the right strategy and level of investment, NI could be a leading hub for clinical trials in the UK and globally; leveraging CoEs focused on trials and data science can further strengthen its reputation for this capability.

Recent developments in the UK

In the UK, there have been both favourable and concerning developments recently regarding the country's position as a hub for clinical trials.

The UK Life Science Vision published in July 2021 by the UK government, includes views on enhancing the country's clinical research, genomic, and health data capabilities.[101] Furthermore, the National Institute for Health Research (NIHR) and KPMG released the "Impact and Value of the NIHR Clinical Research" Network report in 2019, also highlighted the significant impact of clinical research studies on the UK economy, with £2.7 billion in GDP and over 47,000 jobs attributable to trials in 2018/2019. [102]

However, a concerning trend has also emerged. The National Institute for Health and Care Research's data shows England has seen a 35% decline in the number of patients recruited to industry clinical trials from 2017/18 to 2022/23. [102]

The opportunity for NI

Overview of the opportunity

NI has an opportunity to become both a UK and a world leader in clinical trials by leveraging its existing strengths and imminent integrated EHR system.

Integrated care record system: NI launched its national integrated care record system, known as Encompass, in November 2023, starting with the South Eastern Health and Social Care Trust. The remaining four trusts in the region are expected to adopt the system in a staggered manner throughout 2024/25. This clinically-driven care record project will furnish healthcare professionals with real-time data from primary, secondary, community, and social care sectors. As the system comes online, NI should look to nations such as Denmark for best learnings in combining birth / death registry data, hospital information, and biobanks (see corresponding section of this report).

Northern Ireland Clinical Trials Unit (NICT): The NICT is an example of key infrastructure that supports clinical trials in the region. It demonstrates NI's commitment to providing the necessary facilities and resources for conducting high-quality clinical research.

Targeted clinical trials with a small population: With a relatively small population of 1.9 million,[103] NI can facilitate targeted clinical trials, particularly in areas of strength such as oncology and cardiology. Industry stakeholders called for a high-tech, boutique service; aimed around small trials with thoroughly detailed patient information (sampling / diagnostics / imaging, etc), rapid CGT generation, and multiple sample points over time in an intensive care unit (ICU) environment, to cater to ill patients. This would play to NI's strengths and provide a highly differentiated service.

Strong research base and key stakeholder relationships: NI has ~20 companies operating in the clinical trials field and well-developed relationships with key bodies, such as the Wellcome Trust, Wolfson Foundation Clinical Research Facility, and CROs like Celerion, Biokinetic Europe, and O4 Research. [104] These connections foster a collaborative environment and help to streamline the clinical trial process.

Clinical trial management: An aspiration across NI is to further build the capabilities and knowledge across the ecosystem for clinical trial management. This expertise will attract and retain FDI investment, enabling NI to develop into a leader for clinical trial programmes.

The City and Growth Deals

How the Deals build on NI's strength in this area

The CoEs that focus on clinical trials, personalised medicine, and data science could all be multipliers to the value that NI already offers as a clinical trial specialist hub.

iREACH: Located near Belfast City Hospital, iREACH aims to support the set up and delivery of clinical trials. The institute works closely with the HSCTs to facilitate trials and provide the necessary infrastructure for their success.

Causeway Coast and Glens: The Causeway Coast and Glens CGD is expected to have clinical trial capabilities, particularly in the area of nutrition and health.

NI can enhance its clinical trials offering by addressing challenges around the supply of clinical professionals with capacity to oversee trials, developing new policies for unlocking electronic patient records, and by establishing a dedicated ethics committee.

How the Deals build on NI's strength in this area (cont.)

Personalised Medicine Centre (within the School Of Medicine at UU): Providing particular focus on pharmacogenomic biomarker discovery and their application within healthcare, with additional expertise and capabilities in data analytics and MedTech development. The Personalised Medicine Centre also aims to perform robust clinical trials.

Institute for Research Excellence in Advanced Clinical Healthcare (iREACH): Focused on the development and support of innovative design and the delivery of Phase I/II programmes through collaboration within experts, academics, and government organisations within the NI ecosystem.

Centre for Digital Healthcare Technology (CDHT): Located within UU and the Belfast Health and Social Care Trust (BHSCT), CDHT will bring together biotechnology strengths, internationally leading computing-SERG and engineering-NIBEC to forge a CoE dedicated to innovative and increased productivity towards the healthcare technology sector in NI. CDHT can also utilise the strengths of CHIC and ECME as part of their CoE.

GII's Centre for Data Science and Scalable Computing (DSSC): Part of the Global Innovation Institute, the DSSC addresses challenges related to the big data phenomenon. The centre can be leveraged for clinical trial data analysis, utilising advanced data science techniques to optimise trial design, patient recruitment, and data interpretation. Through these CoEs, the CGDs provide a strong foundation for NI to capitalise on its strengths in clinical trials.

What's required to build on the opportunity

Increased supply of clinical professionals to manage trials

A global challenge in clinical trials is the availability of adequate supply of clinical professionals to meet the demand of a growing clinical trials ecosystem. This can be difficult to address, especially for studies that require a specialised medical expertise. The Deals have already moved to address this supply gap, with UU's new School of Medicine providing expanded capacity for medical graduates each year.

Stakeholders consulted for this report also noted that doctors participating in clinical trials must also manage their regular patient care responsibilities. Additional support and structures for the safeguarding of dedicated research hours for clinicians would capitalise on NI's medical capabilities even further.

Unlocking health and social care records

Gaining access to the integrated electronic health and social care records is vital for organisations in NI to benefit from rich patient data. Data could be further empowered by coupling it with biological specimens from patients, etc. A streamlined method of consenting patients for use of their data and samples would unlock more ways to utilise these valuable resources. There is also a desire to engage with existing data resources, as detailed in the Personalised Medicine section of this report.

> "Building on our existing clinical trials capability is not just about jobs and economic growth, it has enormous positive knock-on effects for the NI health system and its patients, who will benefit from receiving new medicines first.
>
> *Pharmaceutical industry consultee*

Aspirational: Therapeutics

NI faces formidable competition from other global hubs to capture therapeutics FDI; an alternative approach of facilitating early-stage and R&D excellence could attract the interest of big pharma and generate value for the NI ecosystem.

Market Context

Recent developments in the UK

The UK recently experienced a disappointment with AstraZeneca's 2021 decision not to locate its new £320m small molecule manufacturing facility in the UK, home of much of its operations.[105] This points towards increasing industry concerns over supply chains and corporate tax rates on high-value manufacturing. However, in late 2021 AstraZeneca opened a £1bn research facility with 2,200 scientists, one of the UK's largest such centres.[106] A similar lesson can be derived for NI, where an R&D focus is likely to capture greater rewards than attempting to attract biotech manufacturing.

The opportunity for NI

Given the entrenched industry and favourable tax environment in the RoI, a head-on competition to attract manufacturing FDI may provide less success than an alternative approach.

Big pharma's shift to collaborations and acquisitions rather than in-house development produces an opportunity to leverage NI's R&D strengths. Spin-outs, start-ups, and other pre-clinical / discovery stage entities could attract the interest of FDI, particularly if a clinical trial and digital infrastructure is present to maximise the value of any partnerships they make. NI has an established LHS support service industry for pharma and biotech, enabling organisations to further collaborate and work closely with NI expertise throughout their life cycle.

NI also has a large workforce in the manufacturing of basic pharmaceutical ingredients in the MSWR. This indigenous ecosystem could create a platform for further growth in established pharmaceuticals as opposed to FDI biotech manufacturing.

The City and Growth Deals

How the Deals build on NI's strength in this area

iREACH can provide the infrastructure necessary to run clinical trials for big pharma.

There is also an opportunity to apply AMIC's excellence in manufacturing, especially in digital twinning, in the existing pharmaceutical sector in NI. CFDD, located in the Causeway coast and Glens CGD, will provide additional drug discovery and pharmaceutical innovation opportunities linked with UU.

> "NI has the opportunity for a cross collaboration with key players in the RoI's pharmaceutical sector. If NI can facilitate or create centres for R&D based on these, it will provide a competitive advantage for both countries on the world stage.
>
> *Pharmaceutical industry consultee*

What's required to build on the opportunity

Enabling innovation

There may already be potential spin-outs in academia or industry which are yet to be commercialised; several consultees suggested the NI ecosystem has ample entrepreneurs, ready to take advantage of more incubator space or increased academia-industry links.

Speed

All LHS companies are keenly aware of the countdown to patent expiration on their products and seek to minimise the delay between molecule discovery and clinical approval. Consultees noted that FDI players will expect a rapid pathway from molecule to medicine, and there is room to make this pathway clearer in NI.

Go to entry point for FDI

Consultees stated that a concierge-style service for FDI biopharma companies would make a compelling offering for NI as it courts investors. The Milner Institute at Cambridge was mentioned as a potential model for industry-partnered consortiums and agreements, with dedicated managers. The Scripps Research institute in San Diego, a biotech hub, follows a similar approach.

07

Our Formula for Continued Success

Creating the right conditions for the sector to thrive

We recommend the formation of a multidisciplinary advisory panel to steer and unify the efforts of NI's local councils in accelerating growth of the LHS sector via their respective relevant CGDs.

Further advancement of CGD progress is possible through structured coordination

Local councils have done an admirable job in advancing the CGD agenda. They have made a compelling business case, demonstrating that each CoE, independently, represents a sound economic investment for taxpayers and the LHS sector.

This achievement is even more commendable considering it was accomplished without an agreed-upon strategic direction for LHS in NI as a region.

Over time, having taken into account the necessary government governance and accountability requirements for the expenditure of several hundred million pounds of taxpayer's money, these CoEs are on the verge of being realised and activated.

Recognising the opportunity for NI to capitalise on its strengths and replicate the success of other LHS hubs, as described in this report, we suggest that the LHS CGDs would greatly benefit from enhanced coordination and stronger alignment with NI's sectoral strengths and goals.

Indeed, stakeholders in NI concur that the CGDs are already serving as a stimulus for the necessary discussions to drive this alignment, especially during the development of this report.

A dedicated LHS advisory panel is a suitable mechanism to drive unity and growth

We propose the establishment of a coordinating body (a 'panel') that represents a range of specialisms within LHS, operating under a unified strategic vision for NI. This panel could provide independent, expert advice on LHS to relevant CGDs and their respective local councils, essentially bringing together the ecosystem. Specifically, the panel would have a mandate for the following activities:

- **Development of an NI LHS strategy to contextualise CGDs:** A single LHS advisory panel would ensure a consistent message, preserving a clear overall value proposition both internationally and within NI. It would clearly communicate the individual and collective strengths of the CGDs, how they interconnect to form a competitive and compelling proposition for investment and research partnerships to both indigenous companies and inward investment organisations.
- **Expert guidance to CGD leadership (i.e. local councils):** The panel would offer expert insights into the LHS ecosystem for local councils, ensuring that CGDs are implemented in harmony with academic and industry objectives, aligning with NI's strategic goals. The panel would prevent duplicative engagements by overseeing business intelligence and partnership outreach. It would strategically guide CoEs to align more intentionally with NI's LHS niches, creating a dedicated playbook for each CoE. This alignment would allow for the CoEs consistent evolution, keeping pace with sectoral and macroeconomic trends.

- **Articulation of engagement pathways for CGDs:** The panel would individually and collectively support CGDs to maintain a clear industry engagement and technology transfer pipeline, facilitating business interactions with the CGDs.
- **Global outreach:** To raise international awareness of the CGDs and LHS activities in the region, the panel would operate in a unified manner, swiftly implementing initiatives and fostering a welcoming environment for both existing and new industry stakeholders, as well as potential foreign direct investment (FDI), through a direct point of contact.
- **Bid coordination:** The panel would assist in identifying and leveraging funding opportunities from UK, Irish and European sources to maximise benefits for the CGDs and the broader LHS ecosystem. This would address concerns about the long-term sustainability of CGDs beyond the initial capital investment.
- **Post EU Exit opportunity mapping:** The panel should also fully map the unique benefits of the Windsor framework and explore what companies and industries could be attracted to NI to capitalise on its benefits.

It is important to acknowledge that local councils must remain responsible for the CGDs, but the aim of the advisory panel would be to give them the support they need to unify their LHS efforts and drive cohesive growth of the LHS sector in NI.

It is crucial to act swiftly by leaning on existing coordination efforts, to advance NI's LHS sector without unnecessary delays.

Structuring and empowering the panel for maximum impact

Incorporating key industrial leaders, academic experts, central government officials, HSCT representatives, and LHS thought leaders into this proposed advisory panel will enhance collaboration within the ecosystem.

There are concerns among stakeholders that creating a new committee or mechanism from scratch might hinder progress and negatively affect the trajectory of NI's LHS sector. Feedback from these stakeholders was that existing and established key networks from NI's LHS ecosystem, such as HIRANI, would be well placed to convene the advisory panel and implement actions.

The leadership of this panel should be a chairperson with the necessary experience, gravitas, and capacity to act as a leading representative for the LHS sector. The role is expected to be highly influential within NI's LHS ecosystem.

Appendix

City and Growth Deals Overview

The three deals profiled in this section represent the most developed and detailed ones available. Limited public domain information is currently available for the Causeway Coast deal.

Belfast Region City Deal

Belfast City Council leads the £1bn BCRD, which has LHS centres for digital health care innovation, clinical trial acceleration, data analytics, agrifood, and advanced manufacturing.

Overview

Focus of the Belfast Region City Deal

The deal revolves around four pillars, in keeping with the wider NI CGD approach;

1. Innovation and Digital, with an emphasis on CoEs with LHS relevance
2. Infrastructure, with £40m for digital connectivity and other ecosystem investment [107]
3. Employability and Skills for inclusion, growth, and the digital future
4. Tourism and Regeneration

Overall objectives

The BRCD is expected to support up to 20,000 jobs, boost Belfast's digital capabilities, and apply these to LHS and other industries. [108]

Centres of Excellence

Centre for Digital Healthcare Technology

Early clinical feedback is key in MedTech and diagnostic innovation, and CDHT aims to enable this by building a Living Lab in the Royal Victoria Hospital, as well as co-locating researchers and industry in a new UU Belfast building. This £40m investment will create an environment to accelerate clinical innovation.[107]

Institute for Research Excellence in Advanced Clinical Healthcare (iREACH)

iREACH provides the next stage in the "bench to bedside" pathway, by providing a point of contact for access to clinical investigators and patients. It also aims to streamline clinical trials, which are crucial in LHS, and is located by Belfast City Hospital.

Global Innovation Institute (GII)

Focused on emerging digital technology, health, and agrifood, the GII will be linked to fintech industries in the Belfast Harbour Innovation District. It builds on the legacy of the Institute of Electronics, Communications and Information Technology (ECIT), whose spin-out company Analytics Engines has applied big data solutions for clients as diverse as TV broadcasters, UKRI, and Almac.

Advanced Manufacturing Innovation Centre (AMIC)

AMIC aims to engage and uplift NI's manufacturing industries. Its flagship project is the "Factory of the Future", which companies and start-ups will be able to use to experiment and prototype their manufacturing processes.

Funding

£1bn of funds are available, £90m of which is LHS specific. The NI Executive and UK Government will each commit up to £350m, while local councils and education partners will together commit £150m. Private funding will "top up" another £150m to bring the sum to £1bn. [109]

Additional details

Partners and key players

UU and QUB are key sponsors of the CoEs, with UU sponsoring the CDHT and QUB leading iREACH, GII, and AMIC. The four higher education colleges in the region are also partners, while Belfast City Council is accountable for funding governance, administration of the funds, and programme management.

Timelines

First announced in 2018 and following business case propositions and discussions, the BRCD document was signed in 2021. Delivery kicked off in 2022, with approval of full business cases, engagement of private partners, and the launch of 17 separate projects including the CoEs. [110]

> “iREACH could streamline clinical trials, reducing the time required from set up to last patient in. NI could be at the forefront of the world’s clinical trials.
>
> *Pharmaceutical industry consultee*

Derry City and Strabane City Deal

The expansion of education and research capacity in the UU School of Medicine, including growth of the Personalised Medicine Centre, marks a new beginning for the LHS sector in the region, with UU, C-TRIC, and the Western Health and Social Care Trust (WHSCT) drawing on their collective strengths.

Overview

Focus of the Derry City and Strabane City Deal

The deal has two project types;

1. Innovation Projects, including two LHS-focused CoEs
2. Regeneration Projects, including tourism, but also skills training and the city Riverfront Regeneration, which will include a UU School of Medicine building

Overall objectives

This CGD aims to triple the rate of employment growth in the region, with a GVA increase of £230m/year by 2030.

The CGD fits into the wider Derry City and Strabane Strategic Growth Plan 2017-2032, which signposts the development of the North Wing building at Altnagelvin Hospital, the North West Regional College, and the city riverfront regeneration as LHS-related aims.

Centre of Excellence

School of Medicine

UU’s first medical students are being trained in a partnership with St George’s, University of London.

The School of Medicine is home to the Personalised Medicine Centre. This is a long-standing research institute, with ~50 research associates / PhDs, ~25 core staff, and links to ~40 clinicians in primary and secondary care in the region. 110 Collaborations have taken place with pharma (AstraZeneca), diagnostics (Almac / Randox) and international universities, utilising twinned genomic and health / social care data.

City Deal funding will establish a new Healthcare Research Institute on the riverfront, which will focus on preventative medicine.

Funding

Total funding is at £250m, with the UK Government and NI Executive providing £50m each. An additional £55m each is folded into the deal, aimed to tackle long-term social and financial deprivation, with local district councils and partners providing £40m to top up the funds to £250m. [111]

Additional details

Partners and key players

Derry City and Strabane District Council, and other partners including UU and North West Regional College (NWRC) are leading the Deal. The WHSCT is a key partner, as is C-TRIC linking companies to the Trusts and aiming to reduce the time to deliver clinical research for industry. These are key partners for the School of Medicine.

Timelines

The Derry Strabane CGD was signed in February 2021, and capital expenditure is underway for major aspects of the program. Funds have already been distributed to established projects such as the Personalised Medicine Centre.

A £1m refurbishment of the UU's School of Medicine building at its Magee campus was completed in 2021, when the doors were opened to the first cohort of students. [112]

> "In NI we have led the way in personalised medicine, and we can back this with our industry interactions.
>
> *Academic consultee*

Mid South West Region Growth Deal

The MSWR has ample strengths in manufacturing and agrifood, and the CGD funding will be used to uplift innovation and realise the region's potential.

Overview

Focus of the Mid South West CGD

As the newest deal to be negotiated, the MSWR Growth Deal aims to capitalise on the region's pre-existing strengths in manufacturing (1), agrifood (2), and pharmaceuticals (3):

Despite having only ~25% of NI's population, the MSWR has ~40% of its manufacturing employment, and the region's medium and high-tech manufacturing employment rate is 170% of the UK average. [113]

11,500 people are employed in agrifood, with ~30% of all NI agrifood firms based in the region. CAFRE has two of its three campuses in the MSWR. [114]

The region's workforce has three times the NI average employed in basic pharmaceutical manufacturing, creating a firm foundation for further growth. [113]

Overall objectives

The primary objective is to close the productivity gap between MSWR and the rest of NI, which would alone produce a 4.3% uplift of the NI economy. The MSWR particularly aims to maximise the opportunities granted by its border with the RoI. The deal also aims to create spaces for innovation, in the form of the CoEs described below. [113]

Centres of Excellence

CAFRE NI Agrifood Robotics Centre (NIARC)

Automation will be key in the future of agrifood manufacturing, and CAFRE will lead this centre in trialling and stimulating innovation in this area.

AFBI Agri-Tech Innovation Centre

Drawing on AFBI's expertise, particularly in horticulture, this centre will explore sustainable food and farming solutions.

Engineering Skills and Innovation Centre (ESIC)

This centre is intended to link to Belfast's AMIC and provide space for companies to trial new approaches, as well as train the workforce for high-value manufacturing.

Funding

The UK Government and NI Executive have committed £250m in Growth Deal funding towards the realisation of the Regional Economic Strategy, and the MSWR intends to seek further funding outside the CGDs to fully complete the strategy. [114]

Additional details

Partners and key players

The councils of Armagh City Banbridge and Craigavon, Fermanagh and Omagh, and Mid Ulster are key leads for the MSWR Growth Deal. ESIC will be led by the Manufacturing & Engineering Growth and Advancement network (MEGA) and Southern Regional College. The region's strength in agrifood is illustrated by its partners AFBI, a research institute, and CAFRE, a higher education provider. They are respectively involved in the Agri-tech Innovation Centre and NIARC.

Timelines

The MSWR CGD was announced in Oct 2019 by the UK Government, and the Regional Economic Strategy outlining the region's ambitions was published in 2020.

> "NI can capitalise on our agricultural land; neither London nor Manchester have that.
>
> *Innovation consultee*

Methodology, Acknowledgements, Glossary and References

Methodology

The analysis in this report is built on a rigorous primary research foundation; Matrix would like to acknowledge and thank all the NI LHS ecosystem participants that took part in consultations and responded to the survey.

Methodology

Consultations

A key aspect of our approach was stakeholder consultations. As part of our thorough approach, we conducted 30 interviews with key stakeholders, including local healthcare businesses, academic institutions, research establishments, support organisations, and representatives from the CGD CoEs. These interactions provided us with invaluable perspectives on how businesses in NI can effectively engage with the centres and the desired outcomes that various stakeholders envision.

Survey

We completed a survey targeting local LHS businesses in NI (n=30), through which we gathered essential data on their current engagement with the CoEs, their requirements, and their plans for future involvement.

Our survey delved into the barriers and facilitators related to engaging with the CGDs, providing insights into areas where local LHS businesses may require additional support. With a sample size of 30 LHS or stakeholder organisations in NI, the survey was fielded between 25-Apr-2023 and 12-May-2023.

The survey findings have offered quantitative evidence to further bolster the qualitative insights obtained during individual stakeholder consultations, enriching our understanding of the opportunities presented by the CGD initiatives.

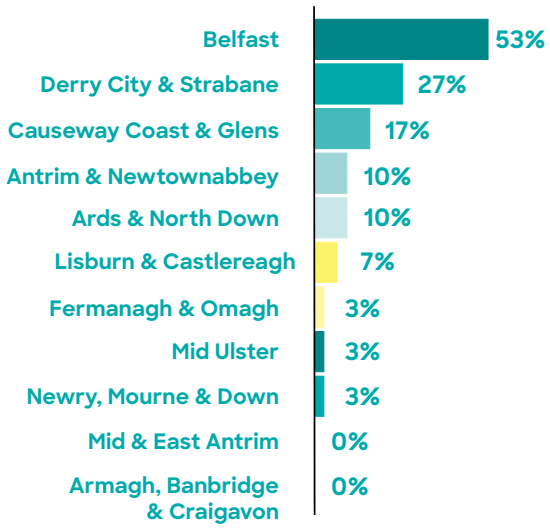
60% of the survey responses are from indigenous firms, meaning that the survey genuinely gives a voice to the domestic sector, to express its needs, wants, and overall viewpoints concerning NI's LHS industry.

Survey demographics

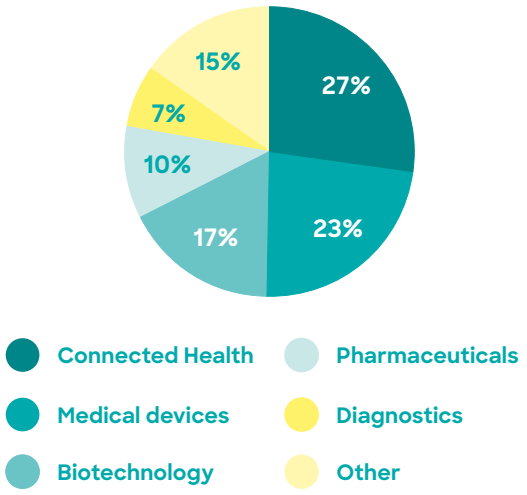
Total responses

N =30

Region represented

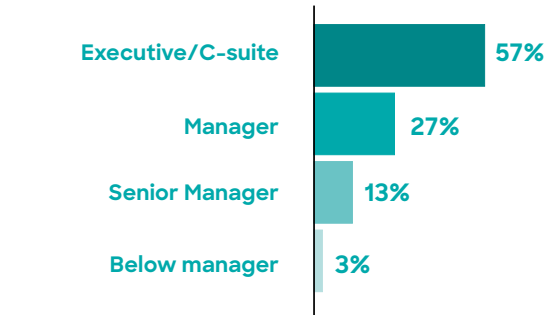


Sub-sector represented

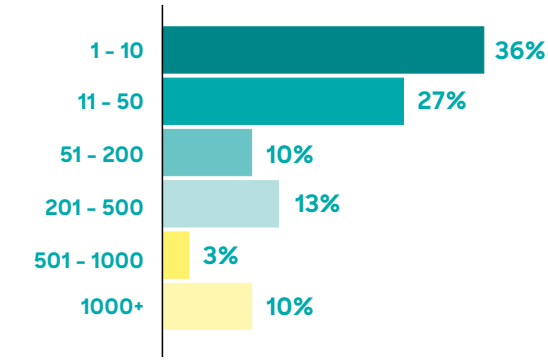


Employees in NI

Seniority of respondent



Employees in NI



Acknowledgements

The analysis in this report is built on a rigorous primary research foundation; Matrix would like to acknowledge and thank all the NI LHS ecosystem participants that took part in consultations and responded to the survey.

Acknowledgements

Matrix would like to to convey sincere gratitude and appreciation towards the individuals and organisations that have played a pivotal role in the development of this report. We wish to acknowledge their support, guidance, and exceptional expertise, which have all been instrumental in ensuring the report's value. Representatives of the following organisations participated in the consultations:

- Almac
- Association of the British Pharmaceutical Industry
- Big Motive
- B-Secur
- Catalyst
- Closed Loop Medicine
- Cumulus Neuroscience
- Department for the Economy
- Department of Health
- Diaceutics
- Exploristics
- Health Innovation Research Alliance Northern Ireland
- Health and Social Care Trusts
- Innovation City Belfast
- Invest NI
- Kainos
- Neurovalens
- Northern Ireland Ambulance Service
- NICON
- Queens University Belfast
- Randox
- Ulster University

Glossary

ABPI: The Association of British Pharmaceutical Industry

AFBI: Agrifood and Biosciences Institute

AI: Artificial Intelligence

AMIC: Advanced Manufacturing Innovation Centre

ASCRO: Association of Swedish Contract Research Organisations

A*STAR: The Agency for Science, Technology and Research

ATMP: Advanced Therapy Medicinal Product

ATU: Atlantic Technological University

BHSCT: Belfast Health and Social Care Trust

BRCD: Belfast Region City Deal

C-TRIC: Clinical Translational Research & Innovation Centre

CAELUS: Care & Equity – Healthcare Logistics Unmanned Aerial Systems Scotland

CAFRE: College of Agriculture Food and Rural Enterprise

CARL: Cognitive Analytics Research Laboratory

CEO: Chief Executive Officer

CDHT: Centre for Digital Healthcare Technology

CFDD: Centre for Food and Drug Discovery

CGD: City and Growth Deal

CHIC: Connected Health Innovation Centre

CIDRA: Centre for Industrial Digitalisation, Robotics and Automation

CMO: Contract Manufacturing Organisation

CoE: Centres of Excellence

CRO: Clinical Research Organisation

CGT: Cell & Gene Therapy

DSSC: GII's Centre for Data Science and Scalable Computing

ECIT: Institute of Electronics, Communications and Information Technology

ECME: The Eastern Corridor Medical Engineering Centre

EHR: Electronic Health Records

ESIC: Engineering Skills and Innovation Centre

EU: European Union

FDI: Foreign Direct Investment

FDA: Food and Drug Administration

FWO: Research Foundation Flanders (anglicised)

GB: Great Britain

GDP: Gross Domestic Product

GII: Global Innovation Institute

GVA: Gross Value Add

GP: General Practitioner

HIHI: Health Innovation Hub Ireland

HIRANI: Health Innovation Research Alliance Northern Ireland

HQ: Headquarters

HR: Human Resources

HSCT: Health and Social Care Trust

HSE: Health Service Executive

ICU: Intensive Care Unit

IDA Ireland: Industrial Development Agency Ireland

IoT: Internet of Things

IUL: Innovation Ulster Ltd

IP: Intellectual Property

iREACH: Institute for Research Excellence in Advanced Clinical Healthcare

IVD: In-Vitro Diagnostics

LHS: Life and Health Sciences

MDR: Medical Device Regulation

MEGA: Manufacturing & Engineering Growth and Advancement network

MET: The Medical and Engineering Technologies

MIC: NIHR MedTech and IVD Co-operative

MNC: Multinational Corporation

MSWR: Mid South West Region

NGI: Newcastle Gateshead Initiative

NIH: National Institutes of Health

NIHR: National Institute for Health and Care Research

NIAS: Northern Ireland Ambulance Service

NHS: National Health Service

NHSA: The Northern Health Science Alliance

NI: Northern Ireland

NIARC: Northern Ireland Agrifoods Robotics Centre

NIBEC: Nanotechnology and Integrated Bioengineering Centre (NIBEC)

NICHE: Nutrition Innovation Centre for Food and Health

NICRN: Northern Ireland Clinical Research Network

NICTC: Northern Ireland Clinical Trials Centre

NUIG: The National University of Ireland Galway

NUS: University of Singapore

NWRC: North West Regional College

QUB: Queen's University Belfast

QUBIS: Queen's University Belfast Innovation Society

R&D: Research and Development

REMEDI: Centre for Cell Manufacturing & The Regenerative Medicine Institute

REF: Research Excellence Framework

RoI: Republic of Ireland

SME: Small and Medium Enterprises

STEM: Science, Technology, Engineering and Mathematics

UK: United Kingdom

UKCA: UK Conformity Assessed

UKRI: UK Research and Innovation

US: United States

USP: Unique Selling Point

UU: Ulster University

UUI: Ulster University Innovation

VLAIO: Flanders Innovation & Entrepreneurship (anglicised)

WHO: World Health Organisation

WHSCT: Western Health and Social Care Trust

XR: Extended Reality

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Published by Matrix April 2024