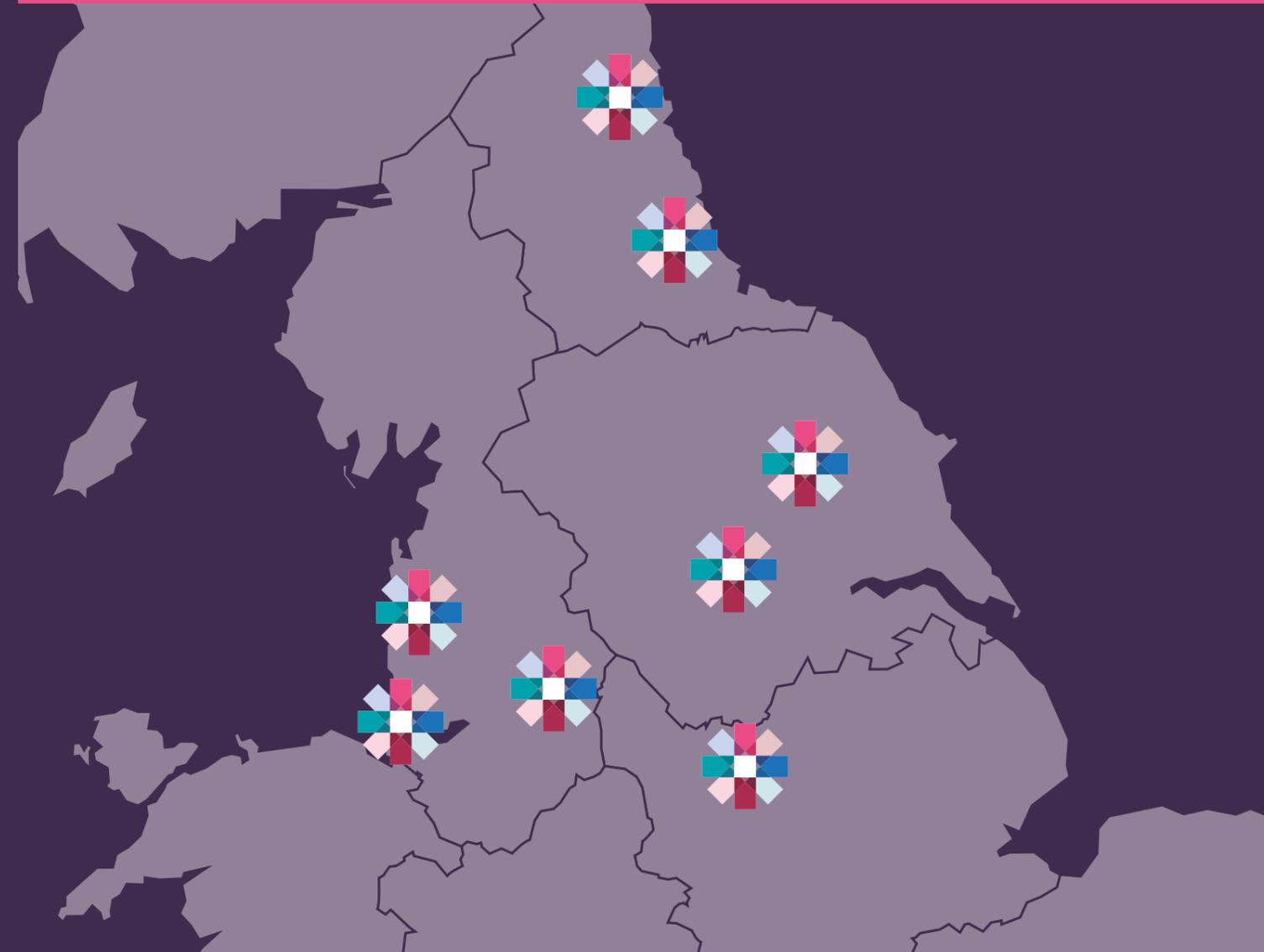


THE NORTHERN POWERHOUSE IN HEALTH RESEARCH



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Executive Summary

Introduction

This Science and Innovation Audit (SIA) highlights the North's potential to drive real-world clinical research across its 16m population by drawing on organisations' and individuals' expertise in, and knowledge of, Health and Life Sciences. It reviews the tangible and intangible assets in the North of England for:

- **Data for Better Health and Wealth**, which is the ability to develop and implement *Learning Health Systems* where progress in Science, Informatics, and Care Culture come together to generate new knowledge as an ongoing outcome of the care process, and deliver continuous improvement in Health and Healthcare¹; and
- **Precision Medicine**, which is the search for, and application of, the right treatment, at the right dose, to the right patient, at the right time.

By working with place-based communities, supported by initiatives such as #Datasaveslives and Connected Health Cities (CHC), and pioneering assets such as the Great North and Leeds Care Records and the Salford Lung Study, the North is in prime position to diffuse and embed digitally-enabled **Precision Medicine** research and application at scale, for the benefit of UK citizens and the national economy.

Our Vision

Our aim is that this SIA plays a vital role in progressing the Life Sciences Industrial Strategy and the proposed Northern Life Sciences Industrial Strategy Sector Deal.

Our vision is that over the next 10 years, the North of England will:

- Be a globally recognised centre for applied Health Innovation with strengths in:
(i) **Data for Better Health and Wealth**; and (ii) **Precision Medicine**;
- Be one of the world's most connected and networked regions for Applied Health Innovation – attracting significant levels of public, private, and voluntary sector investment, based on a track record of excellence in applied Health Innovation;
- Apply Health Innovation by bringing together unique combinations of assets and expertise with which to conduct research;
- Nurture local applied Health Innovation talent in research, clinical practice, entrepreneurship and business management, and attract and retain Health Innovation talent from around the world; and
- Become a healthier and more economically productive place in which to live, narrowing the North's health, wealth, and productivity gaps compared with the South of England.

¹The Institute of Medicine (J Am Med Inform Assoc. 2015 Jan; 22(1): 43–50. Published online 2014 Oct 23. doi: 10.1136/amiajnl-2014-002977).

Context

Our Place and Partners

The footprint of the Northern Powerhouse in Health Research (NPIHR) area is formed by eight cities and their hinterlands: Durham, Lancaster, Leeds, Liverpool, Manchester, Newcastle, Sheffield, and York. The research-intensive Universities in each of these cities form the N8 Research Partnership. The Life Science businesses in the North work collectively through the membership organisation Bionow. Four Academic Health Science Networks (AHSNs)² and 11 Local Enterprise Partnerships (LEPs) operate in the SIA's geography. And the Northern Health Science Alliance (NHSA) works on a pan-Northern basis with these organisations and networks.

Our Economy, Population, and Health

The North of England is an integral part of the UK economy, generating approximately one-fifth of national output. While we have areas of outstanding productivity, such as Cheshire and Warrington, in 2015, GVA per filled job in the SIA footprint was 87 per cent of the UK average (£44,078, relative to £50,830).³ Thus, there is a productivity gap to close.

In the same way that productivity varies by place, so do health outcomes; for example, the chance of dying under the age of 75 is more than 20 per cent higher in the North than in the South of England.⁴ Such inequalities pose many challenges to Health and Social Care providers in the North. In the context of this SIA, the rich diversity of socio-economic and ethnic background at the level of the North is a major asset upon which to build a diverse 'testbed', as we develop Learning Health Systems and Precision Medicine to improve the delivery, efficacy, and value of 21st Century Health and Care.

The North's population's steady and high burden of disease, provides a unique setting to progress applied health research, facilitating an environment ideal for Precision Medicine clinical trials at scale. Such new activity will build on strong foundations – for example, the NPIHR's footprint delivers more clinical trials than London, Oxford and Cambridge combined (30 per cent relative to 26 per cent in 2016-17).⁵ Our area is also home to three of the top ten hospitals in England for the number of clinical trials – the Newcastle Upon Tyne Hospitals NHS Foundation Trust has the highest number of trials nationally.⁶ Furthermore, we have clinical research networks which, in combination, can recruit from across the North, and at all levels and providers of care.

So, we are well-positioned to reap the benefits to be gained from **Data for Better Health and Wealth** both to promote Learning Health Systems and extend the use of **Precision Medicine**. To do this effectively, we require appropriate access to data, at the level of the individual and for defined cohorts with shared characteristics. Furthermore, we need to be able to study the impact of socio-economic status and environmental and civic factors to understand the actual (or potential) efficacy of a given treatment in a place-based context. There is currently a gap in our infrastructure in relation to developing our understanding of environmental and civic factors, which we aim to fill, but additional support and investment are needed to make this a reality.

Against this background, we propose a two-pronged approach to tackling the productivity gap between the North and South. First, we will grow, attract, and retain high value-adding businesses in the North's Health supply chain by providing excellent support for research, trials, and business growth. And, second, we will contribute to labour productivity by improving generational health outcomes in the workforce through the increasing efficacy of treatments that Learning Health Systems and Precision Medicine will enable.

Our Research Funding

Between 2007 and 2017, organisations in the NPIHR's footprint led:

- 1,320 projects (18 per cent of all projects in the UK, and c. 17 per cent of all funding) in areas related to **Data for Better Health and Wealth**; and
- 1,582 projects (c. 17 per cent of all projects and c. 14 per cent of all funding) in **Precision Medicine**.⁷

Research by the UK Clinical Research Collaboration shows that, in 2014, our three Northern regions received 13.5 per cent of funding from 64 funders of health research, this against the North having about 25 per cent of the UK's population.⁸ Of 20 Biomedical Research Centres (BRCs) nationally, we have four in the North (Leeds, Manchester, Newcastle, and Sheffield) – some £816 million has been allocated to BRCs, of which the North has received 7 per cent.

Our SIA is focused on ensuring the appropriate recognition of our research excellence, arguing that by improving radically our capacities, capabilities, and expertise in exploiting Data to promote Learning Health Systems and **Precision Medicine**, we can become still more investable to health research funders and contribute further to the UK's thriving Life Science sector.

Accordingly, over time, we aim to raise the North's share of national Health Research funding to 20 per cent. This will be done through the better coordination of our Health Innovation assets at the level of the North and by working with funders to ensure that, through the quality of the research and application we undertake, more resources are made available for testing and validation as well as for the take-up of innovation in relentlessly improving healthcare systems.

²(1) Academic Health Science Network North East and North Cumbria, (2) Innovation Agency Academic Health Science Network for the North West Coast, (3) Yorkshire & Humber partners Academic Health Science Network, and (4) Greater Manchester Academic Health Science Network.

³ONS (2015), *Regional and sub-regional productivity in the UK*, <https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/labourproductivity/articles/regionalandsubregionalproductivityintheuk/jan2017>

⁴Buchan, I. E., Kontopantelis, E., Sperrin, M., et al (2017), "North-South disparities in English mortality 1965-2015: longitudinal population study", *J Epidemiol Community Health*, 71:928-936, <http://jech.bmj.com/content/early/2017/07/14/jech-2017-209195>

⁵National Institute for Health Research (NIHR) Clinical Research Network (CRN), (2017), *NIHR Research Activity League Table*, <https://www.nihr.ac.uk/research-and-impact/nhs-research-performance/league-tables/>

⁶The other two hospitals in the top ten are Leeds Teaching Hospitals NHS Trust and Sheffield Teaching Hospitals NHS Foundation Trust

⁷Bespoke Technopolis analysis, based on Gateway to research data, 2007-2012

⁸UK Clinical Research Collaboration (2015) *UK Health Research Analysis 2014* <https://hrcsonline.net/reports/analysis-reports/uk-health-research-analysis-2014/>

Key strengths

Data for Better Health and Wealth

In relation to **Data for Better Health and Wealth**, our SIA process has identified:

- The North of England's combination of clinical and research assets, expertise, and networks mean that it is placed ideally to drive the use of Data to promote the speedy introduction of innovation;
- Our clinical assets, in relation to Data, include six Acute and two Mental Health NHS England Global Digital Exemplars, which are internationally recognised for their efficient delivery of exceptional care through world-class digital technology. Our digital maturity scores an average of 18 percentage points higher than the UK averages across the three main assessment areas: Capability, Enabling Infrastructure, and Readiness;
- Our research assets include but are not limited to: the High Performance/Cognitive Computing facility at Hartree (including access to IBM's Watson engine); plus the University of Liverpool's Department of Biostatistics; the Liverpool Health Data Science Network; the Centre for Health Informatics, Computing and Statistics at the University of Lancaster; the Centre for Biostatistics at the University of Manchester's Faculty of Biology, Medicine and Health; the Health eResearch Centre in Manchester; University of York's expertise in Biostatistics and Computing Science (including the York Cross-Disciplinary Centre for Systems Analysis and the Biostatistics Research Group at Newcastle University's School of Mathematics, Statistics and Physics); the National Institute for Smart Data Innovation in Newcastle; and the Leeds Institute for Data Analytics (LIDA);
- The Research Excellence Framework 2014, shows excellence in Computer Science and Informatics at the Universities of Lancaster, Liverpool (which was ranked first for 3* and 4* outputs), Manchester, Newcastle, Sheffield and York;
- Our research expertise, as measured by SciVAL, indicates that, while the volume of academic papers produced in the North has scope to grow, the *quality* of the research we undertake is already of international standard;
- Our networks include Connected Health Cities, which unites local health data and advanced technology to drive research and service provision, and has developed the necessary protocols and approvals to share health data at both volume and geographic scale;
- This combination of world-class assets, knowledge and networks, plus our excellent track record in recruitment to trials, means that the North plays a leading role in novel trial designs, including 'change of practice trials', for example, the world-leading Salford Lung Study, and trials within cohort studies, such as the Born in Bradford Better Start Innovation Hub;
- The North is ideally placed to conduct Real-World Clinical Trials – clinical trials are already a regional strength for the North, with six major academic clinical trials units across the footprint, including one of the largest in the UK, at Leeds;

- The North also has significant clusters of digital health businesses, particularly in its city regions (notably those of Leeds, Liverpool, Manchester, Newcastle and Sheffield);
- Collaboration between business, clinicians and academics is growing e.g. Connected Health Cities is supporting the development of long-term, trust-based relationships between clinicians and researchers and over 70 businesses by establishing a Pre-Competitive Collaboration Consortium focused on data; and
- Earlier in 2018, NHS England invited regions to bid to become 'Local Health and Care Record Exemplars' (LHCRE) with potential funding of up to 7.5million being available for each LHCRE. It has recently been announced that the North has been successful in obtaining LHCRE status in two regions, Greater Manchester and Yorkshire and Humber. The award of two LHCRE to the North is a further strong independent endorsement of the health data strengths in the North and is a strong validation of this SIA. The LHCRE will form a positive force in helping galvanise other internationally leading health data assets highlighted in this SIA.

Precision Medicine

In relation to **Precision Medicine**, the SIA found:

- The NPIHR's footprint's assets include but are not limited to: the Genomics England's NHS Genomic Medical Centres (in Leeds, Liverpool, Manchester, Newcastle and Sheffield); the National Institute for Health Research; four NIHR Biomedical Research Centres; NIHR Medtech and In-Vitro diagnostics co-operatives (in Leeds, Manchester, Newcastle and Sheffield); InnovateUK's Medicines Discovery Catapult and the Antimicrobial Resistance Centre (both at Alderley Park); the UK Pharmacogenetics and Stratified Medicine Network; the Wolfson Centre for Personalised Medicine; the Medical Research Council's Centre for Drug Safety Science; the Centre of Excellence in Infectious Disease Research (Liverpool); expertise in economic evaluation at the University of York's Centre for Health Economics and other groups in the region; the Stoller Centre (Manchester); and the Medical Research Council's Stratified Medicine Consortia (n3), in Manchester and Newcastle;
- We also benefit from two (of three) InnovateUK-funded Advanced Therapies Treatment Centres (ATTCs), which are facilitating the development, commercialisation, and adoption of Cell, Gene and Tissue Engineered Therapies: Innovate Manchester's Advanced Therapy Centre Hub (iMatch); and the Northern Alliance Advanced Therapies Treatment Centre (NAATTC);
- In terms of specific areas of expertise, the Research Excellence Framework 2014 shows academic excellence in: (1) Allied Health Professions, Dentistry, Nursing and Pharmacy at the Universities of Lancaster, Bradford, Leeds, Manchester, and Sheffield; (2) Psychology, Psychiatry and Neuroscience at the Universities of Lancaster, Newcastle, Sheffield and York; and (3) Public Health, Health Services and Primary Care at the Liverpool School of Tropical Medicine and University of Sheffield;
- International collaboration is a vital part of innovation in Precision Medicine, universities in the NPIHR's footprint demonstrate high levels of international

collaboration with over 60 per cent of papers containing at least one international partner, a rate comparable to the UK's best research institutions;

- Collaborative working (between sectors as well as across borders) is vital to the success of innovation in Precision Medicine, such collaboration is supported by multidisciplinary centres that complement our themes e.g. the EPSRC-funded Centre for Maths in Healthcare at Liverpool, the recently funded £2 million EPSRC grant for new approaches to Data Science at Lancaster, and EPSRC investments in Anti-Microbial Resistance at Liverpool, York and Sheffield; furthermore, the NPIHR's 'soft' infrastructure supports collaboration within the North, and between the North and the rest of the world;
- In terms of business, the NPIHR's footprint has nationally significant and complementary clusters of Life Sciences businesses. The North is home to over 12,450 Core Biopharma companies (around 20 per cent of all UK Biopharma firms), employing 21,500 over people (18 per cent of all UK employment in the sector); and around 21,700 Medtech companies (c.22 per cent of all UK Medtech companies), employing over 28,500 people (23 per cent of all UK employment in the sector).⁹
- The North West is strong in therapeutics at Alderley Park and has a core Biopharma and Medtech service and supply chain; Yorkshire and the Humber is strong in core Medtech and Digital Health; and the North East, which has a significant cluster of 17 major pharmaceutical companies including Sanofi and GSK, is strong in Biopharmaceutical service and supply, and core Biopharmaceutical; and
- There is growing diagnostics cluster in the North, including the Abtek Biologicals Mast Group in Liverpool, QIAGEN in Manchester, and Mids Medical at Sci-Tech Daresbury.

Growth opportunities

Bringing together Data for Better Health and Wealth and Precision Medicine

As is clear from the above, the North of England has internationally competitive and globally connected clinical, research, and business assets and capabilities in relation to **Data for Better Health and Wealth** and **Precision Medicine** as separate domains. But if our two themes combined effectively, their assets and strengths could form a uniquely attractive offer to researchers, clinicians, and businesses working on the effective use of data to drive innovation in **Precision Medicine**. In other words, our two themes in combination equip the North to develop as a global centre for **applied Precision Medicine**.

A wide body of stakeholders across our SIA's footprint were asked to think creatively about how such combinations of assets and expertise generate synergies. The following areas were suggested:

- **Real-World Clinical Trials** – building on the platform developed by North West EHealth (as well as strong capabilities across the wider Northern footprint), which

has 1.4 million patient records, and a unique, secure, and safe method for managing pseudonymisation and re-identification for Real-World Evidence, and from which the North can establish a novel, world-leading unique platform. Furthermore, Liverpool and Leeds Clinical Trials Unit have established e-trial platforms and experience across multiple studies, including comprehensive strengths in clinical trial design. Utilising the combined strengths of real-world data and adaptive clinical trial design, the NPIHR SIA partners are positioned to conduct robust and unbiased evaluations of **Precision Medicine** technologies and methods, with prior consent, and to being monitored pre-disease to enable longitudinal studies – recruiting people for clinical trials using live data for identification and accessing data at the point of care would underpin this work;

- **Ageing** – Ageing Society has been identified by the Government as one of four Grand Challenges in the UK Industrial Strategy, the NPIHR partners can build on their age-related assets, such as the National Innovation Centre for Ageing (NICA) and the MRC Arthritis Research UK Centre for Musculoskeletal Ageing, a collaboration of three N8 Universities, with a number of pan-Northern population health-based initiatives, including scaling the activities of the five Active and Healthy Ageing (AHA) Reference Sites, which are now working together through the AHA North initiative on areas such as Falls Prevention, Frailty, and Bone Health;
- **Anti-Microbial Resistance (AMR)** – building on assets and expertise, particularly those in the North West, the North is well-placed to lead Precision Medicine research into AMR which, posing a significant threat to current treatment practice, has huge market potential. The key area for development here is both the support for a dedicated AMR cluster in the North West, as well as a national clinical trials platform for AMR that could be established first in our SIA geography; and
- **Predicting future health needs in the population** – linking such findings to (a) the most effective treatments; and (b) preventive measures/treatments.

⁹<https://www.gov.uk/government/publications/bioscience-and-health-technology-database-annual-report-2017>

Gap analysis

Stakeholders identified a number of challenges specific to **Data for Better Health and Wealth** and **Precision Medicine**, along with challenges related to our ability to bring the two themes together.

Data for Better Health and Wealth

The issues to address, if we are to make the most of the opportunities arising from **Data for Better Health and Wealth**, are:

- World-wide skill shortages in Bioinformatics (and the underpinning skills, such as Statistics and other Mathematical Sciences), Pathology, Microbiology, Genome Sequencing, Health Economics, and Clinical Trial Methodologists;
- The need to encourage more and deeper cross-discipline working, as a means of using skill and expertise sets in new and novel ways;
- Improving access to finance to enable firms to scale-up, as well as the need to build the management skills of growing businesses; and
- Optimising the synergies, linkages, and connections with other relevant SIAs elsewhere in the North and the wider UK (such as the emphasis given to High-Performance and Cognitive Computing and Infection in the Liverpool+ SIA, and Applied Digital Technologies in the Oxfordshire SIA).

Precision Medicine

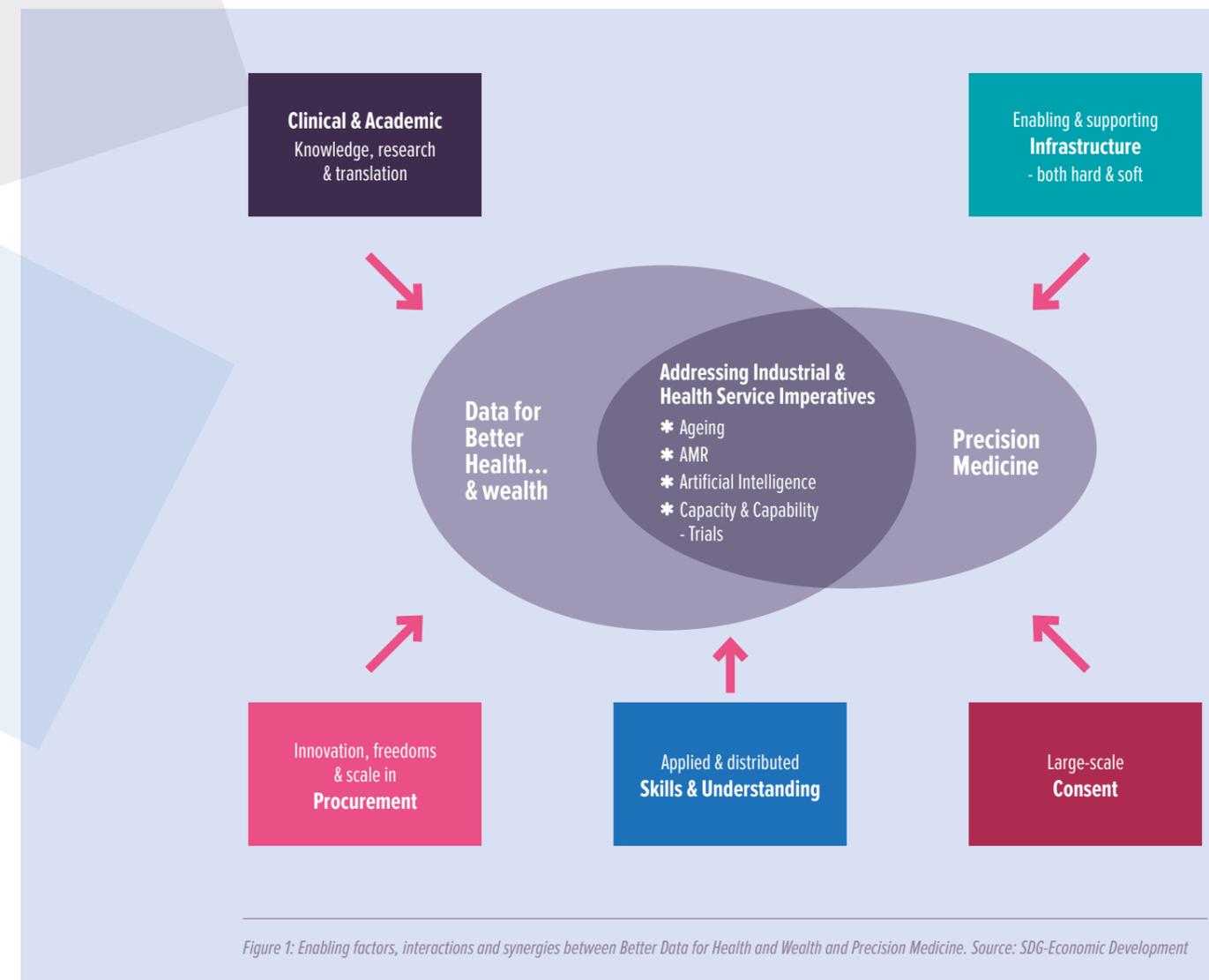
The issues to address, if we are to maximise the health and economic benefits of the North's potential in **Precision Medicine**, include:

- A lack of pan-regional fully joined-up infrastructure to conduct real-world precision trials at scale;
- Insufficient funding and support for scale-up businesses in **Precision Medicine** (notwithstanding the good work already being done e.g. at Alderley Park);
- The slow adoption and application of innovation in the NHS, due to, among other things, conservative procurement processes, cultural issues, and crucially a lack of engagement by clinicians (often due to wider NHS pressures), with the latter meaning that researchers and companies tend to push products from a technology perspective, and in ways which are not always aligned with the patient pathway/ Health and Care system;
- A workforce that has not been sufficiently trained in the skills required fully to exploit the opportunities offered by **Precision Medicine**, including cross-team working and entrepreneurial and business management skills; and
- Optimising the synergies, linkages, and connections with other relevant SIAs elsewhere in the North and the wider UK (such as Scotland's SIA focused on Precision Medicine Innovation, and Medical Technologies in the Leeds City Region SIA).

Gaps in our capacity to bring our two themes together

Figure 1 illustrates the interaction between the two themes, the specialisms in which the NPIHR is well-placed to build international and commercial collaborations, and the enabling factors which, if strengthened, will drive our growth. The SIA process identified five 'enabling factors' that determine our ability to innovate at scale and speed, and which inform our proposed 'targeted opportunities' described below. These are:

- Clinical and academic excellence in knowledge;
- 'Hard' and 'soft' enabling and supporting infrastructure;
- Arrangements for large-scale consent to support Real-World Clinical Trials;
- Skills and understanding of **Precision Medicine** to support learning health systems; and
- NHS regulation and procurement to support the adoption and diffusion of innovation at scale.



Key proposals

The specialisms, enabling factors, and the issues and constraints highlighted by stakeholders have informed our development of 'targeted opportunities'.

Our Targeted Opportunities

Given our established strengths and our analysis of the challenges and barriers to growth, we have identified six targeted opportunities that will enable us to stay ahead where we lead, and to achieve excellence in new and growing markets. These comprise our 'asks' from this SIA:

Extending Connected Health Cities

- The Health North/Connected Health Cities (CHC) initiative is creating a world-leading partnership using large-scale data to drive public sector reform in health and social care;
- The original CHC funding was for the pilot of the project, and was linked to potential future scale-up capital;
- An extension to CHC will enable the development of almost 16 million consented population based on the Great North Care record, and its various sub-regional equivalents, that will complement the UK Life Sciences Industrial Strategy. The latter seeks, among other things, to improve the speed and efficiency of UK clinical trial capabilities and to support collaboration between the NHS and industry for the benefit of patients;
- CHC also has significant export potential, with existing discussions regarding collaboration with colleagues in Australia, USA, Canada, Brazil, Turkey, and Singapore based on the platform being demonstrated through CHC; and
- The funding requirement over the next five years, based on experience to date, is estimated at **£25 million capital, and £75 million revenue.**

Extension of the Northern Health Science Alliance (NHSA)

- The NHSA performs a vital animateur and coordinating role, working with Universities, Academic Health Science Networks and NHS Teaching Hospitals, plus engaging with business;
- It currently handles around 35 private sector enquires a year, translating around 90 per cent of these into formal R&D projects; and
- The funding requirement for NHSA over the next five years, based on experience to date and expectations of future demand, is estimated at **£3-5 million revenue.**

Development of a Centre/Collaborative for Civic Computation

- This will involve co-locating physical and digital facilities with the CHC data analytic centres at regional science parks across our SIA geography. The latter can accommodate industry partners, so optimising the opportunities for clustering, as well as ensuring activity is visible to the public, thereby helping to build public trust in the increasingly sensitive and high-profile 'personal data' domain;

- The CCC will drive regional and national growth by working closely with CHC, entrepreneurs, and existing businesses to develop digital health products and services. It will establish a programme in Civic Data Science research alongside a Centre for Doctoral Training, addressing an acute need in the rapidly expanding Digital Health and allied Digital Civic segments; and develop a cohort of Computing and Mathematics Fellows;
- The precise form of the asset needs to be worked through, but it could take the form of a single facility for the North, a network of nodes across the North, or the North leading as part of a national collaboration in civic computation. Links to, and synergies with, Health Data Research UK will be key; and
- The funding requirement over seven years is estimated at **£10-15 million capital and £25-40 million revenue** – based on benchmarking with other Centres.

Development of a Precision Medicine Academy

- An **Applied Precision Medicine Academy (APMA)**, focussed on delivering coordinated training and knowledge transfer across the North, will build on partners' outstanding track record in innovative clinical academic training – this includes the Modernising Scientific Careers Programme under Health Education England; the NIHR National Dean for Training (Liverpool); the National Lead for Training in the NIHR Infrastructure, NIHR Infrastructure National Training Forum Chair, and NIHR Rare Disease Training Lead (all in Newcastle); and
- Further work is required to determine the scale of the Academy and the breadth of Allied Health Professional courses that it will cover. Initial estimates indicate **annual running costs of around £2-4 million a year**. In the first instance, an **estimated £75,000 is required for a Concept Feasibility Study** – based on previous similar feasibility studies.

Development of Real-World Clinical Trials

- The NHTA and the team at North West eHealth (NWEH), which ran the Salford Lung Study, plus the wider Northern platform will scale-up the North's offer on Real-World Clinical Trials. Wider expertise will be drawn in from other centres of specialist clinical trials expertise, such as the UKCRC's Clinical Trials Research Centre (Liverpool) and Clinical Trials Research Unit (Leeds). Similarly, the Wolfson Centre for Applied Health Research Medicine is seeking to research Health Inequalities in the Leeds-Bradford area;
- This opportunity is complementary to, and supportive of, the Life Sciences Industrial Strategy, which aims to establish two to five regional innovation hubs providing data across regions of three to five million people. The NWEH and the broader Northern platform is a ready-made regional innovation hub, able to take forward work identified in the Life Sciences Industrial Strategy; and
- The funding requirement for this is estimated at **£20 million over five years**, which, based on our experience of partnership working to date, will unlock at least twice as much in private sector investment.

Freedoms and flexibilities in Procurement and Funding

- The NHTA, working in partnership with NHS Trusts, AHSNs, and the newly developing NHS Northern Procurement Hub will explore fresh ways for the North of England to procure innovation at scale, with the aim of identifying any procurement barriers to the introduction of pan-Northern innovation procurement. The estimated cost of a **Scoping Study for this opportunity will be £100,000** – based on the need for specialist procurement expertise and the scale of the processes to be reviewed; and
- The NHTA will work with researchers, businesses and LEPs to prepare a Business Case for LEPs which have prioritised the Life Sciences to have the freedom to support work to develop and validate new products, processes, and services delivered to the NHS. Based on previous work, the **estimated cost of this case-making activity is a further £140,000**.

Figure 2 provides a logic model which summarises our overall approach.



Figure 2: NPIHR SIA Logic Model. Source: SDG-Economic Development

Networking and collaboration

Producing the SIA

This is a partnership-led and -built document, drawing on the rich and diverse mix of Health, Care, Business, Academic, and wider intermediary agencies across the North of England's Data, Health and Care, and Life Science communities. The Northern Health Science Alliance has coordinated these activities. The Alliance itself is an independent not-for-profit company limited by guarantee. Its governance structure includes the eight leading research intensive NHS teaching hospitals, the N8 universities, and the four northern Academic Health Science Networks.

All of the AHSNs, and the seven of the North's LEPs that are prioritising Life Sciences for sector development, have participated actively in the production of this SIA, and will be key partners in its delivery and execution. These partners ensure, and will demand, a high level of place-specificity to the implementation of our SIA. In particular, the North's AHSNs have for a number of years been working collaboratively across the North to share know-how, expertise, and capability. Accordingly, the North is one of the best networked UK regions in having AHSNs collaborating at scale. Our AHSNs have a proven track record of joint working, and collaborating, with partners in industry, in particular around the validation and uptake of novel products and devices. Our AHSNs also work on a single Innovation Pathway¹⁰ aligned to the North's agreed research areas, ensuring they leverage the combined 'power' of the North's NHS Trusts.

The SIA process specifically facilitated discussions which led to identification of the synergies to be developed from the interactions between Data for Better Health and Wealth and Precision Medicine, the specialisms in the North that are most likely to yield results, and the enabling factors which need to be strengthened if we are to maximise the impact of the SIA. The debates, initiated by the SIA, led to the development and refinement of our targeted opportunities.

Delivering this SIA

The SIA process has also focused partners' minds on next steps. In the initial phases of delivering the recommendations and suggested outcomes from this SIA, the NHTA will act as the governing body in the first instance. However, to reflect the full breadth of the North's health innovation economy the NPIHR will establish a Leadership Steering Group to support the implementation and delivery of the SIA's recommendations and next steps. The NPIHR joint leadership steering group which will involve members from the NHTA, regional trade bodies, such as BioNow and LEPs, as well as directly involving the senior leadership from relevant companies to guide and inform the implementation of the SIA outputs. The NHTA is in the process of agreeing the governance model for the NPIHR SIA Leadership Steering Group with relevant stakeholders.

The NHTA is grateful for all the thinking, advice, data, wider evidence, and constructive challenge that partners have offered as part of the process. Our thanks go to all those who participated.

¹⁰http://www.thenhsa.co.uk/app/uploads/2016/04/NHTA_EMAIL_VERSION.pdf. Led by the AHSNs, The Innovation Pathway supports the route which companies need to take, ensuring that viable ideas are protected and developed, markets are assessed, and valuable evidence and clinical trial data is generated, in order to expedite the adoption and dissemination process and ultimately lead to success.