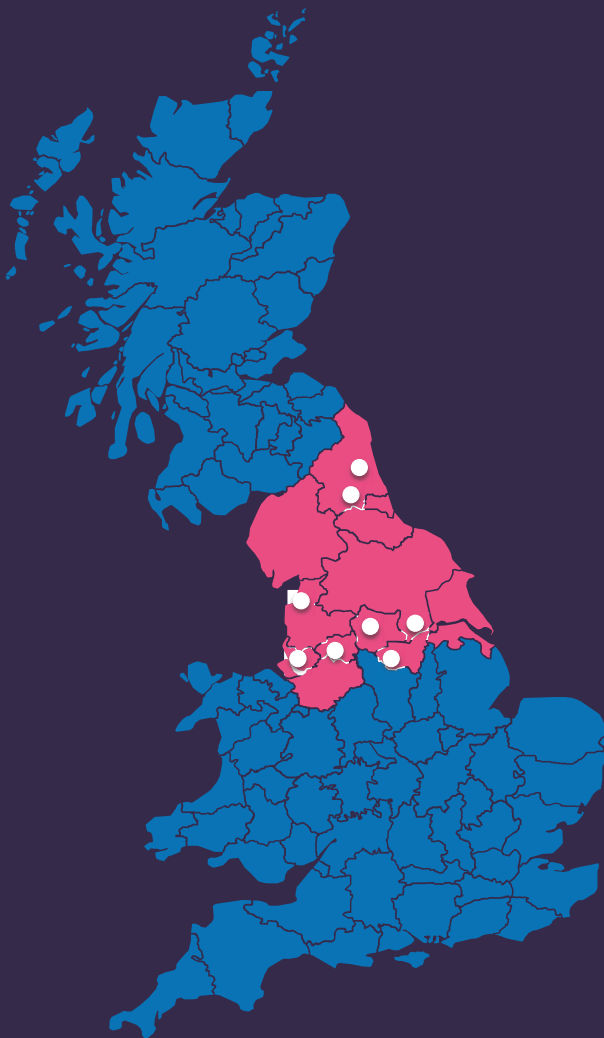


Right place, right time

The Northern Life Sciences Opportunity



FIRST EDITION

FOREWORD

Life sciences is an important sector to the UK; its importance has been recognised at all levels of government and that is why in 2011 we launched the Strategy for UK Life Sciences. This was the first industrial strategy launched by government, and recognised the range of assets and capabilities across the country, including the North of England.

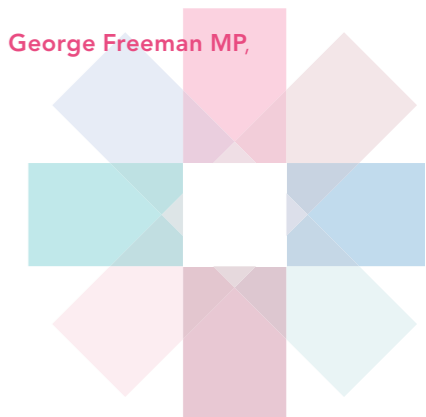
The strategy was based on the fact that the old model of life sciences discovery focussed on academic discovery and the traditional model of 'R&D', which is fundamentally changing. 21st century medical research will be far more centred on patients and the clinical infrastructure of tissues, data, and patient involvement in research. Our vision is for the UK to pioneer this new model of clinical, academic and industrial "translational medicine" which the Northern Health Science Alliance is doing so much to develop. The Government's life sciences strategy is already delivering, with industry now working far more pro-actively with, and investing in, life sciences.

To achieve economic success for the UK, we must maximise expertise and talent across the country. The launch of the Life Sciences Opportunities for the North of England is a strong reminder that businesses and universities in the North have an important role to play in delivering the full potential of UK life sciences. The North of England has a rich heritage of innovation and with the right support can help secure a lasting presence for the UK on the international life sciences stage.



// As Minister for Life Sciences I will be working with the Government to help unlock the role of life and health sciences in the new Northern Powerhouse that this Government has committed to delivering. //

Foreword from the Rt Hon George Freeman MP,
Minister for Life Sciences



INTRODUCTION

WHO WE ARE

The North of England represents a significant powerhouse of life sciences capability. Collectively we have life sciences research and commercial operations in 1,000 businesses, supporting 38,000 high skilled jobs. Alongside this commercial community, the N8 universities (Durham University, Lancaster University, University of Leeds, University of Liverpool, University of Manchester, Newcastle University, University of Sheffield and University of York) include four of the Global Top 100 universities in life sciences and have generated over 220 patents in the last 10 years creating over 250 spin-offs. The N8 universities have an annual research income of £788m (17% of the UK sector) including £78m from industrial partners.

The N8 universities are working with a range of world-leading multi-nationals such as AstraZeneca, GlaxoSmithKline, Johnson & Johnson, Unilever and Procter & Gamble, together with a thriving emerging SME community such as Proteus Digital Health and Sectra. Together the academic and business community is building the scale and expertise to drive growth across the UK.

As one example, the North has world-leading expertise across our universities in ageing research – from neurodegenerative diseases to bone and joint problems. An illustration of our collaboration is the MRC Arthritis Research UK Centre for Integrated Musculoskeletal Ageing (CIMA), where Sheffield lead on bone, Liverpool on muscle and Newcastle on ageing, creating world leading capability to address conditions such as arthritis or osteoporosis. We make a real difference by working together, and our forward plans are set out in this document.

Working as the N8 Research Partnership since 2007, we bring together our academics to work on a range of research challenges. We developed the N8 Industry Innovation Forum to act as a single point of access for industry. More recently we have formed the Northern Health Science Alliance (NHSA) to establish, with our NHS partners, an internationally recognised life sciences and healthcare hub in the North of England. The NHSA provides unrivalled access to healthcare innovation for the benefit of industry, academia and patients. Since its formation, the NHSA has secured fourteen business engagements ranging from partnership agreements to securing inward investment into the North. In addition the NHSA has been working to coordinate responses to national funding calls such as the Precision Medicine Catapult. Together we will ensure that UK life sciences competes on the global stage bringing economic and health benefits not only for the North of England but also the UK.

The North of England has the academic firepower and the industry potential to lead life sciences research. This is the right place and the right time. We look forward to working with you on this journey.

Professor Ian Greer, Chair Northern Health Science Alliance

Professor Nick Wright, Chair of N8 Executive Management Group

// Right place and right time. //



The N8

A Research Partnership of the eight most research intensive universities in the North of England: Durham, Lancaster, Leeds, Liverpool, Manchester, Newcastle, Sheffield and York. The N8 universities work together on collaborative programmes of scale and significance. These are demand-led and innovation-inspired, driven by the needs and challenges of industry partners and research users.

The NHSA

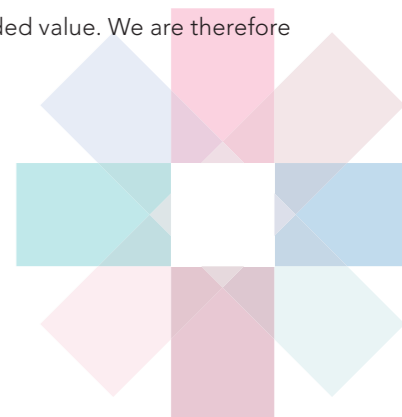
The Northern Health Science Alliance Ltd (NHSA) is a partnership established by the leading University Medical Schools and associated NHS Hospital Teaching Trusts in the North of England, and includes the northern Academic Health Science Networks. The NHSA was established to improve the health and wealth of the region by creating an internationally recognised life sciences and healthcare system.

The NHSA covers a patient population of over 15 million, and acts as a single portal bringing together research, health science innovation and commercialisation to provide benefits for researchers, universities, hospitals and patients, as well as commercial partners.

A unique collaboration

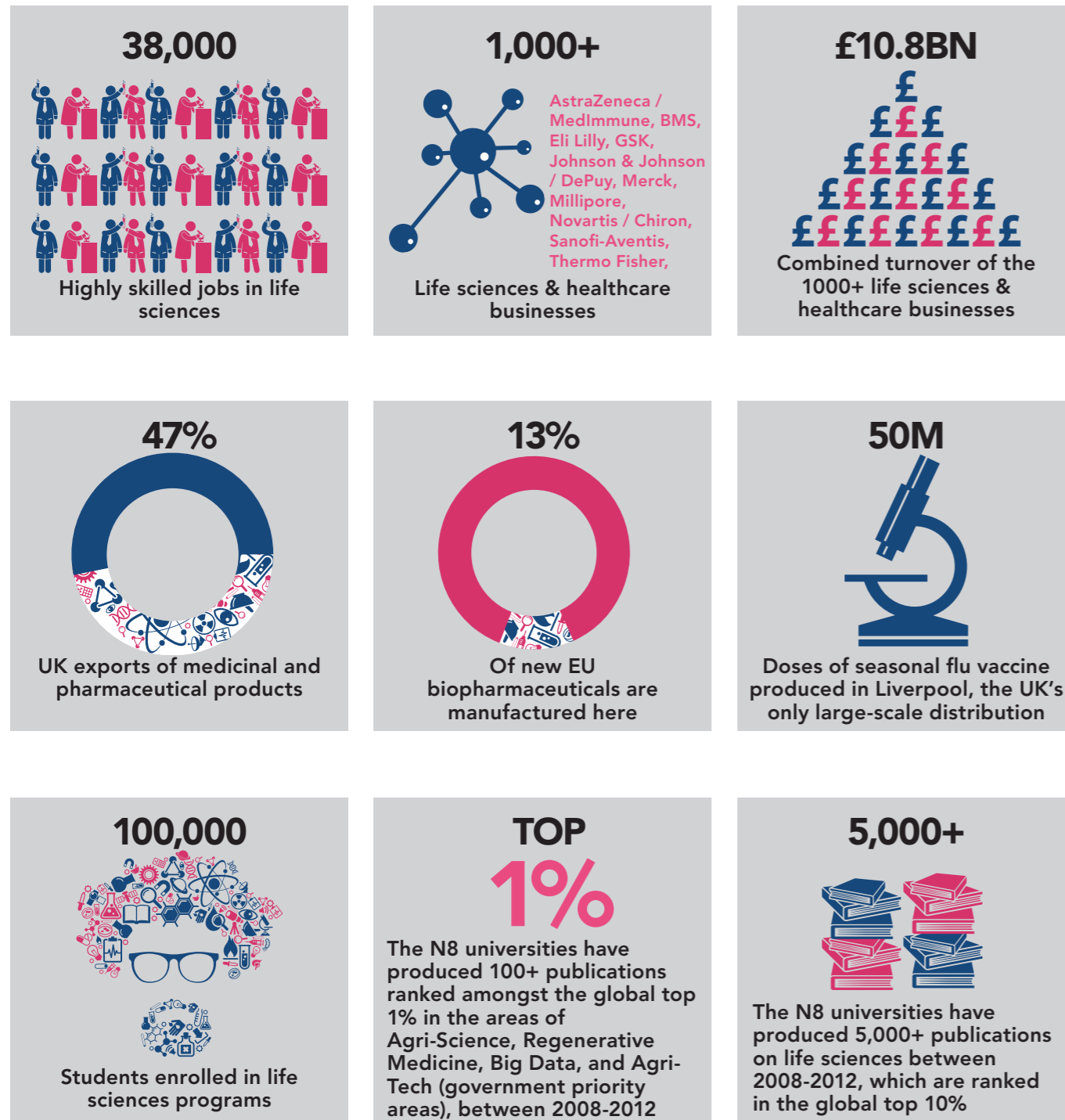
The N8 and NHSA partnerships have a high level of complementarity and generate significant added value. We are therefore well-placed to innovate and exploit the potential of life sciences research.

// Creating an internationally renowned life sciences and healthcare partnership. //

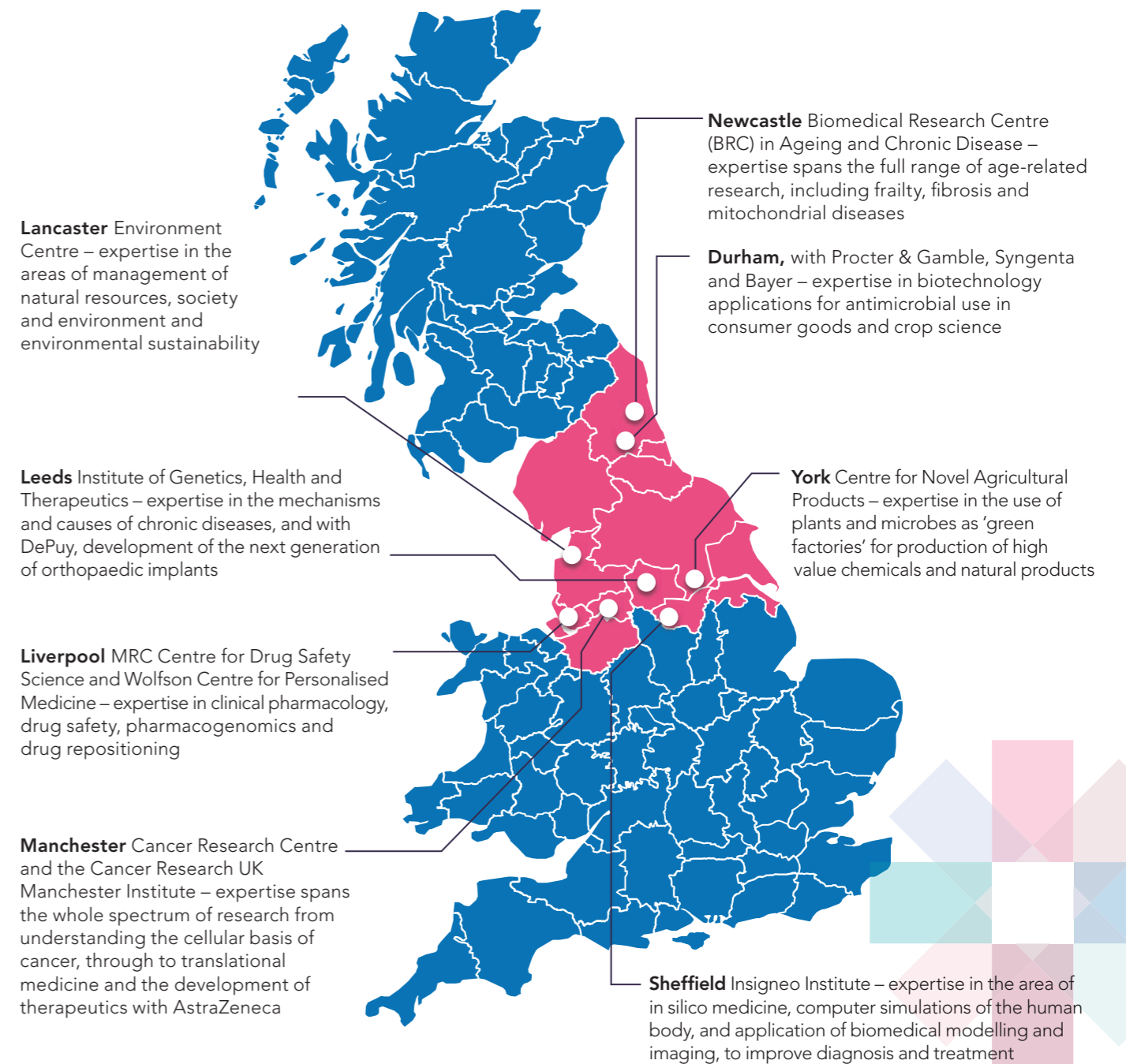


THE POWER OF THE NORTH

THE NORTH: DRIVING INNOVATION THROUGH ACADEMIC EXCELLENCE



Research across the North spans the full breadth of basic, applied and translational research. Some of our leading areas of expertise include:



Reference sources for data are listed on page 15

BIONOW/INDUSTRY

GLOBAL CHALLENGES AND OPPORTUNITIES

A unique, distinctive, vibrant and joined-up industrial sector

The North hosts a thriving life and health science business community:

- Home to 1000 life sciences and healthcare companies, generating a turnover of £10.8bn and supporting 38,000 highly skilled jobs.
- Strong production and export market in medicinal and pharmaceutical products, with total exports of over £8.1bn, representing 47% of classified UK exports and a balance of trade of £4.7bn.
- Particular strength in industrial biotechnology, biologics (antibodies, therapeutic proteins and vaccines), small molecule therapeutics, wound care, orthopaedics.
- Excellent downstream and translational expertise and capability which complements other clusters in the South East.

The sector benefits from a specialist cluster support organisation – Bionow. Bionow has championed catalytic investments worth £88m, which leveraged over £440m into the sector and supported inward investment opportunities for over 100 companies. With linkages to around 1000 businesses and over 225 subscribing members, Bionow is currently the fastest growing life sciences membership organisation in the UK. Working alongside the N8 and the NHS, Bionow is committed to driving innovation in the sector by catalysing the engagement of the Northern Universities, NHS and a business base with scale, breadth and a unique nature.

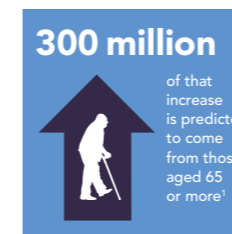
Case study

The North: The right place for sustainable bio-manufacturing

- Speke, Liverpool, adjacent to Liverpool airport, is home to specialist manufacturing facilities owned by multinational companies Eli Lilly, Medimmune and Novartis. Over 1500 employees work at these facilities, representing the largest concentration of biomanufacturing capability in Europe.
- The Novartis plant is the only injectable vaccine manufacturing facility on UK soil, and one of the largest producers of flu vaccine in the world, it saw a massive influx of workforce and upscale in output upon the recent swine flu outbreak.
- Speke was the chosen site for the National Biomanufacturing Centre (NBC) – a unique facility catalysed by Bionow, enabling access for small and medium sized companies to the specialist facilities needed to manufacture biopharmaceuticals for clinical trials. Now owned and operated by Actavis, the site employs over 200 people.

The NHSA and N8 Universities have come together to tackle major global challenges in the area of Life Sciences:

Demographic and social change: the world's population is growing and ageing



How do we address the challenges of a growing and ageing population?

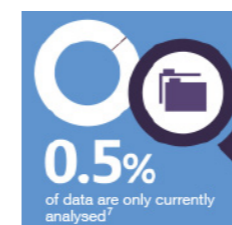
- The world population is growing and by 2025 there will be another billion people in the world to feed – with the total estimated at 8 billion
- People live longer with fewer children; the fastest growing segment of the population is the over 65s. It is estimated that 30% of the additional 1 billion people by 2025 will be over 65. This phenomenon is causing an increase in prevalence of age-related disorders (e.g. dementia, co-morbidities and

musculoskeletal ageing) which are currently areas of unmet clinical need

- Securing and sustaining the food supply for a growing global population is a challenge that is further compounded by the effects of climate change in the regions of highest population growth. Advances in sustainable bio-manufacturing and multi pest-resistant crop research have the potential to transform the lives of billions of people



Information Technology is changing our world in previously unimaginable ways



How do we harness opportunities presented by changing IT?

- Data are now generated at a phenomenal rate. The ready availability of information and information technology to entire populations is having unexpected and unpredictable consequences across the globe
- For example, the cost of genome sequencing in 2001 was \$96m. In 2014, this is now under \$1000 per genome, a level that makes the application of precision medicine possible
- By using these complex big data we can understand disease better, make more precise diagnoses and so deliver personalised treatment that is safer, more efficacious and cost-effective



Reference sources for data are listed on page 15

NORTHERN CAPABILITIES

THE NORTH: THE RIGHT PLACE, THE RIGHT TIME

The N8 universities and NHTA have combined strengths and capabilities that make the North the right place to compete internationally and address key global challenges:

THE RIGHT PLACE FOR FOOD SECURITY AND SUSTAINABLE AGRITECH

The region has a range of complementary strengths in food security, supported by five university research farms and an established network of over 80 industrial partners:

- With its research farms, Centre for Rural Economy, NU Food Research Facility and Human Nutrition Research Centre, interdisciplinary research at Newcastle is providing insight into integrated animal and crop production systems and their nutritional benefits.
- The Lancaster Environment Centre focuses on the management of natural resources, society and environment, ecology, and conservation and environmental sustainability.
- York has extensive expertise in accelerated breeding techniques as well as genetic modification, to produce crops resistant to disease and extreme weather, a fundamental element in the international food security agenda.
- The Durham Centre for Crop Improvement Technologies is conducting world-leading research on crop tolerance to drought, insect pests and microbial pathogens, and hosts a European Hub for plant cell bioimaging.
- The Leeds School of Food Science and Nutrition focuses on food chemistry and biochemistry, food colloids and processing, and nutrition and public health.
- Liverpool's Institute of Infection and Global Health, brings human and veterinary research together to focus on global health challenges, e.g. tracking emerging and zoonotic infections, and enhancing food safety and food security.
- Sheffield hosts a major climate-controlled plant growth facility. Growth chambers simulate a range of past and future environments and enable work on plant production and protection.

The vision – Deliver a Food Security and Technology Programme providing integrated solutions across the food system from production through supply chain, all the way to health, nutrition and consumption.

THE RIGHT PLACE FOR AGEING RESEARCH

The N8 universities are addressing ageing through research into neurodegenerative disease and mental health, musculoskeletal disorders and mitochondrial research as well as development of assistive devices:

- Newcastle University hosts the National Centre for Ageing Science and Innovation (NASI), the centre is focused on research to improve the health and well-being of older people by developing new technologies and services to support older people to continue to live in their own homes and remain socially active for as long as possible.
- The Newcastle Institute of Ageing and Health is a virtual ageing institute for dementia, geriatric medicine and social gerontology, which spans biological, clinical and social research on ageing, including innovative NHS clinics for complex age-related conditions including frailty.
- The Centre for Ageing Research (C4AR) at Lancaster is developing spectroscopic tools for diagnosis of neurodegenerative diseases, including Alzheimer's disease, whilst emphasising the social science and public health aspects of an ageing society.
- The Centre for Assistive Technology and Connected Healthcare (CATCH) at Sheffield is focussed on developing assistive devices to enable independent living.
- The Leeds Musculoskeletal Biomedical Research Unit delivers novel diagnostics, disease stratification and regenerative therapies for arthritic disease. The Unit collaborates with three other national centres within the Institute of Medical and Biological Engineering, which is focussed on musculoskeletal and cardiovascular repair.

The vision – A Centre of Excellence in Ageing and Vitality (CEAV), which will be a globally unique, integrated environment where world-class scientific, medical, social and technological solutions will be forged to address the needs and opportunities of an ageing population.

NORTHERN CAPABILITIES

THE RIGHT PLACE FOR SUSTAINABLE BIO-MANUFACTURING

The N8 universities exploit synthetic biology strengths to produce high value chemicals and pharmaceuticals through sustainable processes. Over half of the thirteen partners involved in the national BBSRC Networks in Industrial Biotechnology and Bioenergy (NIBBs) are led from within the N8 universities, including Manchester, York, Durham and Sheffield. Other examples of our success include:

- The York Centre for Novel Agricultural Products engineers plants as factories for high value chemicals.
- The Manchester Institute of Biotechnology (MIB) uses industrial biocatalysis and metabolic engineering to develop biosynthetic approaches for sustainable manufacture of biopharmaceuticals.
- The Biopharmaceutical Bioprocessing Technology Centre at Newcastle focuses on a range of applications including cell engineering, bioprocess design and analytics.
- The Astbury Centre at Leeds and MIB at Manchester conduct fundamental research underpinning advances in applied synthetic biology.
- The Chemical Engineering at the Life Science Interface (ChELSI) facility at Sheffield is an interdisciplinary institute that adopts approaches from chemical engineering and exploits advances in biology to improve engineering processes.

The vision – Develop a Centre for Sustainable Bio-Manufacturing: focused on manufacturing methodologies of biologically active molecules through sustainable processes.

THE RIGHT PLACE FOR PRECISION MEDICINE

The North has all the component parts to deliver on a Precision Medicine (PM) agenda:

- The MRC Centre for Drug Safety Science and Wolfson Centre for Personalised Medicine in Liverpool, recently strengthened through a £5m MRC award to utilise systems pharmacology approaches to identify mechanistic biomarkers to target drug treatments.
- The University of Manchester has recently been awarded £13m by the Medical Research Council to establish a Clinical Proteomics Centre with a further £5 million to establish the Manchester Single Cell Research Centre (SCRC) focused on single cell genomics.
- Access to several clinically-coded biobanks, including the UK Biobank based in Manchester, for use in biomarker discovery and to design stratified approaches to cancer and non-cancer treatments.
- York Centre for Health Economics and the School of Health and Related Research in Sheffield are the UK's foremost centres for health economics, and through collaborations with NICE and other centres, work to establish new health economic models for precision medicine.
- Manchester's expertise in eHealth and data analytics is now being deployed across the North through the North West ehealth initiative.
- NIHR Clinical Research Facilities (including the only MHRA-accredited academic unit in England and Wales located in Liverpool), Cancer Research UK Centres (including the Manchester Super Centre), Wellcome Trust-funded trial centres and a range of leading Contract Research Organisations in the area, provide access to public and private sector clinical trials support.

The vision – All the key requirements for Precision Medicine are present in the North. Coordinating these component parts delivers a compelling case for funding.

NORTHERN CAPABILITIES

SUCCESS STORIES

ENABLERS

The N8 universities have significant capabilities and facilities that are required to underpin advances in life sciences research. The high level of connectivity across the N8 Universities and NHSA members provides strong service offerings. The N8 and NHSA promote opportunities across the following:



THE RIGHT PLACE FOR DATA ENABLED HEALTH AND DATA ANALYTICS

The N8 Universities have facilities for high-performance computing (HPC) and expertise in the application of HPC for advanced computational biology research. Examples include:

- Sci-Tech Campus at Daresbury, home to the UK scientific community's HPC facility.
- Hamilton Supercomputer at Durham.
- Quantum Technology Centre at Lancaster.
- Leeds Centre of Health Informatics and Disease Registry Datasets.
- MRC HeRC, Farr Institute of Health Informatics Research and NorthWest eHealth at Manchester.
- EPSRC-funded Postgraduate Centre for Cloud Computing in Newcastle.
- Insigneo Institute for in silico Medicine in Sheffield.
- York based data-sharing platform, YouShare, for sharing of software and mining of data over the cloud.

Developing – The North as the go-to place for data-enabled health science research and data analytics in life sciences. Creating links with N8 disciplines in materials and computer science to further strengthen expertise in this field.



THE RIGHT PLACE FOR CLINICAL TRIALS RESEARCH

The North is a key centre for UK clinical trials and as a result of these strengths has secured innovative new partnerships with GSK and Pfizer. Key trial centres include:

- NIHR, MRC and Wellcome Trust Centres for trials research.
- Durham's Wolfson Research Institute for Health and Wellbeing.
- Clinical Research Facility (CRF) at the Royal Liverpool Hospital.
- Alder Hey paediatric NIHR Clinical Research Facility.
- Trials Methodology Research Centre (MRC & NIHR) between Manchester, Lancaster and Liverpool.
- Six of the N8 partners have UKCRC registered clinical trials units: Manchester, Liverpool, Newcastle, Sheffield, Leeds and York.

Delivering – The North is an innovative location for developing efficient and novel practices for clinical trials and providing a gateway to link industry, academic and clinical stakeholders.



THE RIGHT PLACE FOR HEALTH ECONOMICS & OUTCOMES RESEARCH

The North has the expertise and a track record in health economics and outcomes research:

- The York Centre for Health Economics provides consultancy and research in health economics to the NHS and the pharmaceutical and health care industries.
- The School of Health and Related Research (SchARR) in Sheffield, focuses on health services research, health economics and public health.
- The MRC funded Health e-Health Centre (HeRC) - is a collaboration between Manchester, Lancaster, Liverpool and York. The Centre explores new ways of harnessing electronic health data to improve care for patients and communities.

The increased importance on real-world patient outcomes for reimbursement decisions is a top priority for the pharma industry.

Known For – The go-to place for health economics and outcomes research, underpinning biomedical research and the development of novel interventions, supporting assessments for novel technologies and surrogate endpoints.

DURHAM UNIVERSITY BECOMES P&G's GLOBAL BUSINESS DEVELOPMENT PARTNER

Building on its exceptional capabilities in surface science, biophysical sciences, manufacturing and consumer psychology, Durham has partnered with Procter & Gamble and secured £6m funding to support the work of more than 150 researchers across a range of projects, including the generation of skin, hair and non-clinical anti-microbial products. The University's long-term focus on consumer goods research and development was recognised by Procter & Gamble with the award of 'Global Business Development University Partner of the Year' for 2012.

UNIQUE MEDICAL TECHNOLOGIES INNOVATION AND KNOWLEDGE CENTRE (IKC) AT LEEDS

Leeds has formed a successful partnership with more than 60 companies to accelerate delivery of medical technologies and regenerative therapies to patients. The IKC focuses on developing enhanced methods to diagnose and target individual patients in the areas of stem cell therapy, medical devices for longer lasting joint replacement, biological scaffolds to replace damaged tissue and protein biosensors to diagnose disease and monitor responses to treatment. The commercial development of these new technologies has the aim of delivering '50 active years after 50'. The success of this national centre is evidenced through £60m investment from the private sector to exploit the intellectual property it has generated.

A PIONEERING RESEARCH PARTNERSHIP NETWORK ON REAL WORLD DATA

Manchester has recently established a unique collaborative network of life sciences partners to assess clinical treatments in real life settings outside randomised control trials. The network includes North West e-Health, the University of Manchester, Salford Royal NHS Foundation Trust, local GPs, community pharmacists and the global pharmaceutical company GlaxoSmithKline. The objective of a £36m Salford Lung Study is to test pre-licence intervention, and the safety and efficacy of new asthma and COPD treatments compared to standard medications. Integrated patient records, across primary and secondary care, enable the assessment and ensure close monitoring of patients, with minimal intrusion on their everyday lives.

HEALTH RESEARCH CENTRE OF EXCELLENCE

The MRC-funded Health eResearch Centre (HeRC) is one of only four centres of excellence in the country and has been set up in collaboration between Manchester, Lancaster, Liverpool and York universities. The HeRC is exploring new ways of harnessing electronic health data to improve care for patients and communities. The focus of the Centre is to produce computer-based methods and tools for applications in own health monitoring using mobile technology, examining complex flows for targeted care opportunities, tools to identify new targets for treatment, analyses of healthcare records and making clinical trials efficient.

THE CENTRE FOR INTEGRATED RESEARCH INTO MUSCULOSKELETAL AGEING

The MRC-Arthritis Research UK Centre for Integrated research into Musculoskeletal Ageing (CIMA) is a collaboration between researchers and clinicians at the Universities of Liverpool, Sheffield and Newcastle. CIMA aims to understand why our bone, joints and muscles function less well as we age, and why older people develop clinical diseases of these musculoskeletal tissues, such as arthritis or osteoporosis. The Centre brings together complementary and specialist expertise in skeletal muscle, bone, cartilage and tendon biology, ageing research, nutrition and exercise interventions, and clinical excellence in musculoskeletal disorders.

A BIOMANUFACTURING HUB FOR WORLD-CLASS PROCESS DEVELOPMENT

The National Biomanufacturing Centre (NBC) is a £30m joint investment by the North West Development Agency, UK Government and Bionow, to promote production of small-scale biopharmaceuticals. The facility is an integrated biopharmaceutical development facility providing a hub for process development, current Good Manufacturing Practice and analytical development services for a comprehensive range of biopharmaceutical product technologies. The NBC has close collaborations with Liverpool and Manchester, together with strong industry support from Eli Lilly (which holds the largest bulk biotechnology facility in the UK) and MedImmune.

THE FIRST CLINICAL RESEARCH ORGANISATION TO BE AWARDED INSPIRE SITE STATUS BY PFIZER

Newcastle-upon-Tyne Hospitals NHS Foundation Trust is the first clinical research organisation in the UK to be awarded INSPIRE site status (Investigator Networks, Site Partnerships and Infrastructure for Research Excellence) by Pfizer. The partners will share knowledge and experience of medicines research to bring innovative new medicines to patients in the UK and around the world. Newcastle Hospitals will be a Pfizer-preferred international site for potential future research studies, enabling patients to have access to the latest treatments through clinical trial programmes.

// The UK is now a much more attractive location for clinical trials. //

David Cameron, Prime Minister – commenting on Pfizer choosing Newcastle Hospitals Trust to be one of its international sites for clinical research

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- N8 NSHA Life Sciences Strategy Workshop 1, Leeds, 26 June 2014
- N8 NSHA Life Sciences Strategy Workshop 2, Manchester, 7 July 2014



GET IN TOUCH

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// Right time to
invest in the North. //

