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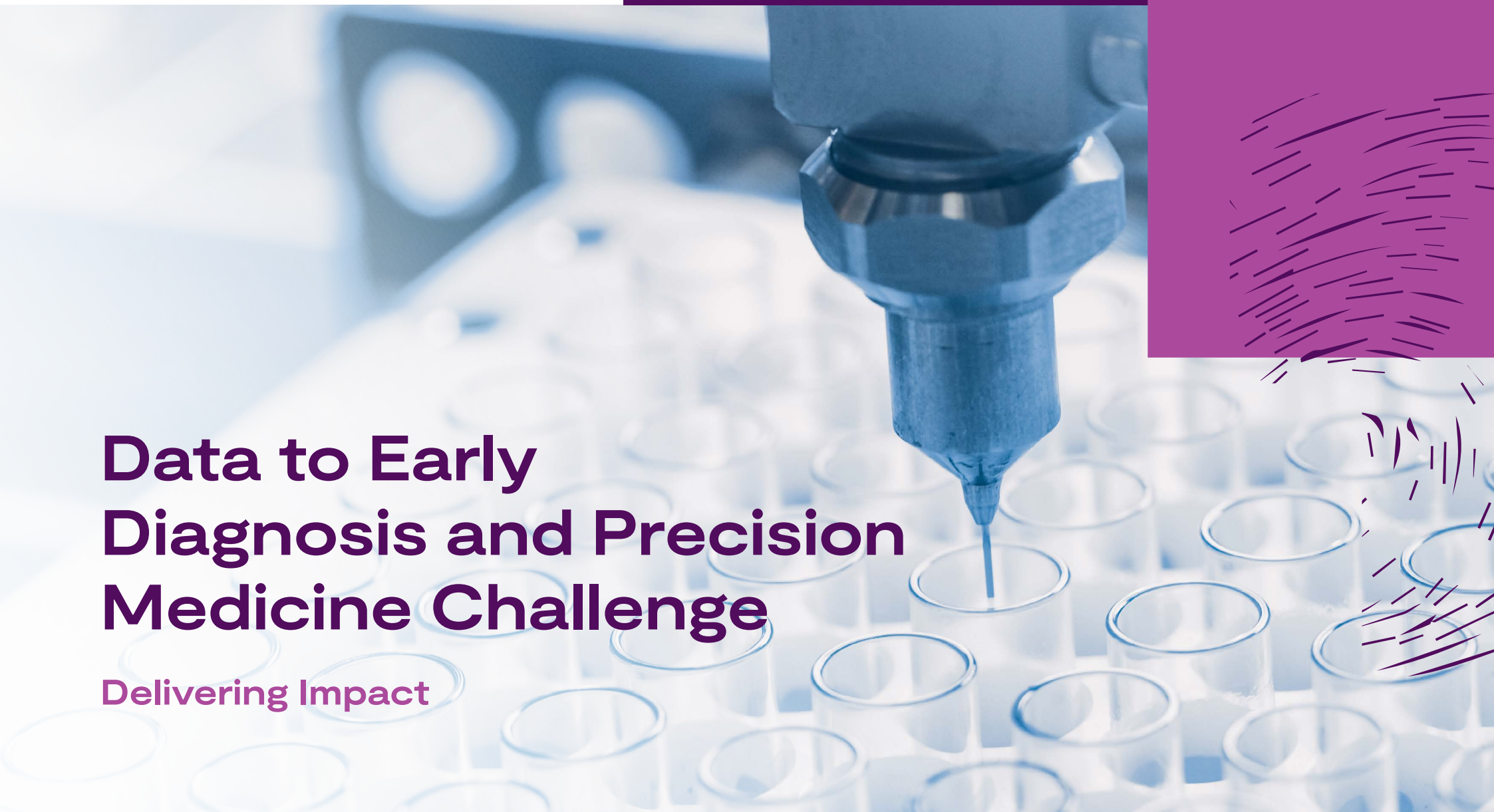


Data to Early Diagnosis and Precision Medicine Challenge

Delivering Impact

The information contained in this brochure is correct as of February 2023

Contents

Foreword by Dr Ian McKay

Challenge Director
Data to Early Diagnosis and Precision Medicine Challenge

The UKRI Data to Early Diagnosis and Precision Medicine Challenge was delivered by Innovate UK and the Medical Research Council. The Challenge was designed to support the development of earlier and more accurate diagnostics, improving patient outcomes by promoting an integrated approach.

The programme involved significant investments delivered across three distinct fields: **genomics**, **health data**, and **diagnostics**. In addition to targeted investments, it supported a series of interdisciplinary diagnostic projects, several in collaboration with Cancer Research UK.

Funding from the Challenge enabled Health Data Research UK to improve the accessibility of health data, making an ever-expanding collection of datasets available through the Health Data Research Innovation Gateway. It also supported the creation of the UK Health Data Research Alliance that involves almost 100 organisations driving the development and implementation of best practices for the ethical use of UK health data at a national scale.

To further expand the UK's genomic resources, the Challenge established a £200m consortium to complete the whole genome sequencing of the 500,000 participants in the UK Biobank programme. The consortium represented a new collaborative funding model with £50m from UKRI attracting £100m co-investment from four pharmaceutical companies and £50m from Wellcome Trust. The availability of genomic data significantly enhances the value of the longitudinal data already held by UK Biobank, showcasing the UK's continued leadership in genomics.

A particularly ambitious element of the Challenge was the creation of five centres of excellence in digital pathology and imaging that together involved 127 different organisations. Each centre was anchored within the NHS and designed to foster collaboration between industry and academia. The centres have accelerated the roll-out of AI-based diagnostics across the NHS by defining pathways for the development, evaluation, and deployment of AI-solutions.

The collaborative development of the Challenge with industry delivered tangible impacts and noteworthy co-investments. The Challenge has highlighted the additional diagnostic value of taking an integrated approach that combines genomics, imaging, and health data to enable earlier and more accurate diagnosis.

135
Project Partners

£210.3m
Total Challenge Fund investment

£654.9m
Follow-on investment

Genomics

£91.9m
Challenge Fund investment

£131.7m
Direct co-investment

DigiPath

£76.7m
Challenge Fund investment

£58.6m
Direct co-investment

Digital Innovation Hub Programme

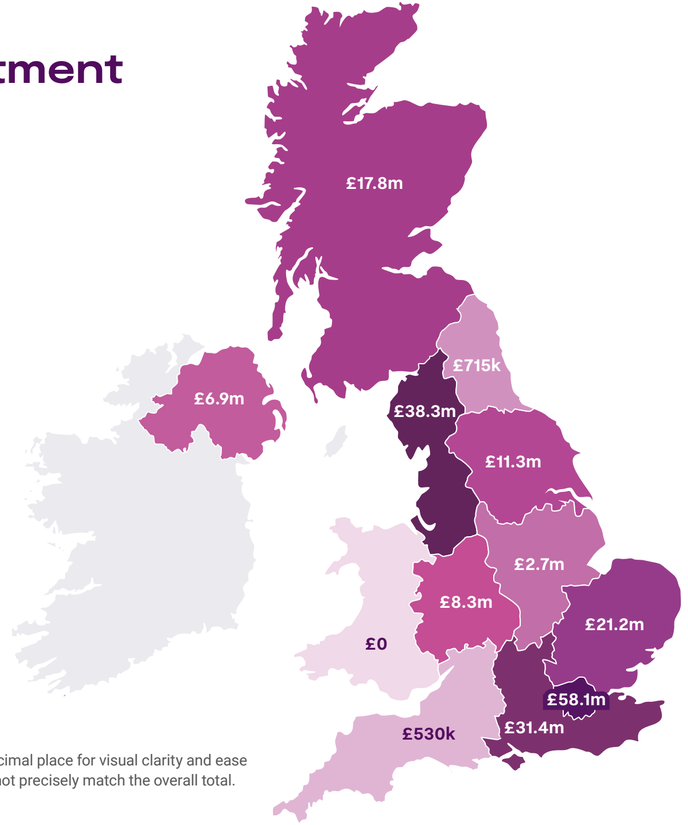
£41.7m
Challenge Fund investment

£34.5m
Direct co-investment

Funding and Investment

by Region

East Midlands	£2.7m
East of England	£21.2m
London	£58.1m
North East	£715k
North West	£38.3m
Northern Ireland	£6.9m
Scotland	£17.8m
South East	£31.4m
South West	£530k
West Midlands	£8.3m
Yorkshire and The Humber	£11.3m
Other*	£12.5m
Total	**£210.3m**



* Investment for UK Biobank sequencing through Johnson & Johnson Services Inc

All figures presented on this page have been rounded to one decimal place for visual clarity and ease of interpretation. As a result, the sum of individual figures may not precisely match the overall total.

Key Impacts

500,000

UK Biobank participant genomes sequenced and made accessible for research thanks to a £200m public-private partnership. This milestone fuels growth in the biotechnology sector, positions the UK as a leader in genomic diagnostics, and enhances its competitiveness in the global market.

149 national datasets focused on major diseases, curated through Digital Innovation Hubs, bolstering the UK's healthcare R&D capabilities. This initiative supports the growth of UK diagnostic, imaging and pharmaceutical businesses while attracting investment in healthcare innovation.

Contributed to the **digitisation of NHS pathology, optimising laboratory networks and processing workflows.** This effort has resulted in the **collation of 4.7 million digital pathology images and the automation of 118,000 imaging reports,** optimising efficiency, and enhancing patient care.

The Health Data Research Innovation Gateway hosts 843 health datasets, with 3,419 registered users, driving research, collaboration and innovation in the UK healthcare ecosystem. Centralising a diverse range of datasets accelerates research and catalyses innovation across the sector, improving patient outcomes.

The DigiPath initiative has **developed 14 comprehensive training programmes, equipping 1,807 clinicians and 6,926 researchers with cutting edge skills in digital pathology and data analytics.** This has supported the development of Centres of Excellence, attracting investment, driving innovation and improvements in healthcare delivery.

Introduced **22 state of the art data storage facilities across 25 NHS sites, modernising healthcare data management.** These facilities allow collation, sharing and storage of data, driving workflow improvement, collaboration, and research.

Established Centres of Excellence have spearheaded:

- **68 pioneering projects**
- **Delivered 18 advanced AI tools**
- **A further 46 in development**

This initiative showcases the UK's capabilities in AI development and diagnostics, supporting market growth and driving sector employment.

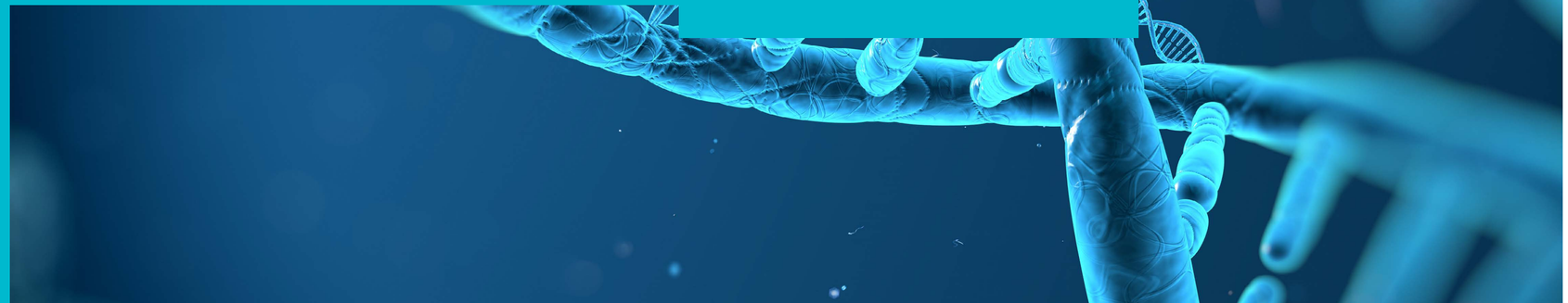
The Challenge has demonstrated tangible returns on strategic investments within the precision medicine sector. It has stimulated an **estimated £655m of follow-on investment** highlighting its economic impact, reflecting confidence in UK healthcare innovation and growth opportunities for UK businesses.

Genomics

£91.9m
Challenge Fund investment

£131.7m
Direct co-investment

£262.6m
Follow-on investment



Genomics, the first of three Challenge strands, supported UK leadership in precision medicine by exploiting capabilities in large scale Whole Genome Sequencing.

It included the following workstreams:

UK Biobank Whole Genome Sequencing

The Challenge funded Whole Genome Sequencing of the UK Biobank's 500,000 participants. This presented an opportunity to generate genomic data at scale, and use it to enrich existing longitudinal patient data. This enriched data can enable better understanding of the underlying causes of disease and allow precision medicine approaches based on genomics.

Genomics England Cancer Whole Genome Sequencing

Genomics England secured funding through the Challenge to undertake Whole Genome Sequencing in eight cancer-related clinical trials. A key objective was to expand the database for underrepresented cancers, held within the National Genomic Research Library.

Genomics Cancer R&D

A cancer R&D competition funded small and medium sized enterprise (SME) innovation projects to utilise or produce Whole Genome Sequencing data for cancer analysis. This focused on the development of clinical tools and biomarker identification for the development of new, bespoke therapeutics.

Cancer R&D Projects:

Perspectum Diagnostics Ltd, University of Oxford and Hampshire Hospitals NHS Trust Oxford - Integrated Whole Genome Sequencing into care for patients with liver tumours

Mosaic Therapeutics Ltd and Wellcome Trust Sanger Institute - Whole Genome Sequence - Guided targeting of colorectal and oesophageal cancers

Tailor Bio - Whole Genome Sequencing of liquid biopsies to predict doxorubicin response in ovarian cancer

Base Genomics Ltd and Oxford University - A novel method for single-step, ultra-sensitive, combined DNA methylation and mutation detection of cancer from liquid biopsies using Whole Genome Sequencing

My Personal Therapeutics Ltd and Imperial College London - Personalised therapies based on simultaneous targeting of complex oncogenic networks identified by Whole Genome Sequencing

Roche Products Ltd, Durham University, Concr Ltd and Christie NHS Foundation Trust - Carcinoma of Unknown Primary Site (CUP) - A comparison across tissue and liquid biomarkers (CUP-COMP)

UK Biobank Whole Genome Sequencing

Case Study

Using a unique store of medical samples, this project aimed to revolutionise gene-based medicine.

With funding from a consortium established by UKRI, the world's largest genomics project has been completed. The Whole Genome Sequencing Project sequenced the entire genetic code of half a million volunteers, helping to build a detailed picture of serious and life-threatening illnesses including cancer, heart diseases, dementia and diabetes.

The UK Biobank enabled this project with its expansive archive of blood, urine and saliva samples, accompanied by comprehensive donor profiles.

Established in 2006 by the Medical Research Council and Wellcome Trust, UK Biobank recruited participants from across the UK aged between 40 and 69 through to 2010. The UK Biobank has become a globally important medical data resource, with continually updated samples, hospital, and GP records accessible to researchers for studies. This longitudinal participant data allows health tracking, increasing the value of the resource.

The UK Biobank has evolved into an incredibly rich dataset. With 500,000 participants, it offers a unique opportunity to uncover rare conditions and explore genetic variability, providing insights into disease predisposition.

Since its establishment, the resource has been accessible to researchers worldwide and serves as a vital asset in global health research, driving our collective knowledge and understanding of health related issues. UK Biobank was central to the reaction to COVID-19, recruiting in excess of 115,000 volunteers over a four week recruitment drive, allowing researchers to track antibody response to the virus.

The Whole Genome Sequencing project, launched with a £50m investment from UKRI, brought together four leading biopharmaceutical and healthcare companies, Amgen, AstraZeneca, GlaxoSmithKline and Johnson & Johnson, who collectively contributed £100m in funding, alongside an additional £50m from Wellcome Trust. Not only will this initiative improve the diagnosis of a wide range of diseases but it will support the development of new, bespoke treatments, reinforcing the UK's position as a leader in healthcare.

DigiPath

£76.7m
Challenge Fund investment

£58.6m
Direct co-investment

£56.3m
Follow-on investment

The DigiPath strand supported earlier and more accurate diagnosis of disease within digital pathology, radiology/ imaging and diagnosis, through two workstreams: Centres of Excellence (CoE) and Integrated Diagnostics (IDx).

Centres of Excellence (CoE)

£59m
Challenge Fund investment

£43.3m
Matched funding

The Challenge provided £50m to establish a network of Centres of Excellence across the UK in digital pathology and medical imaging, including radiology.

The centres are specialised collaborations between clinicians, scientists and industry partners, focusing on advanced research. Their objectives were to use digital systems and artificial intelligence (AI) to improve diagnosis and deliver precision treatments.

Each Centre has established partnerships across the NHS, academia and industry, driving the development and adoption of innovative technologies including AI.

Challenge investment supported the development of methodologies to diagnose diseases at an earlier stage, improving clinical decisions and patient care.

The five Centres of Excellence:

ICAIRD - Industrial Centre for Artificial Intelligence Research in Digital Diagnostics, **Glasgow**

NPIC – National Pathology Imaging Cooperative, **Leeds**

PathLAKE - Pathology Image Data Lake for Analytics, Knowledge and Education, **Coventry**

NCIMI - National Consortium of Intelligent Medical Imaging, **Oxford**

LMI4VBH - London Medical Imaging and AI Centre for Value-Based Healthcare, **London**

National Consortium of Intelligent Medical Imaging (NCIMI)

Case Study

£9.5m

Challenge Fund investment

NCIMI, as led by the University of Oxford, consists of a consortium of 35 partners including 12 NHS Boards, 1 academic and 14 industry partners.

The project led to the creation of an annotated repository of patient data with informed research consent to address specific healthcare problems. Additionally, it supported the development of software and processes towards the production of AI medical devices.

NCIMI developed and tested AI tools through 20 exemplar projects (higher than the original target of 9) with focus on cancers, heart disease and metabolic conditions.

Impact

53 publications

160 UK events to promote projects

35 Overseas events to promote projects

9 Regulatory approvals for AI tools

13 Enquiries from new potential business partners

20 exemplar projects

11 AI tools in development

4 AI tools developed

8 AI tools validated

13 new data storage facilities

1 New data sharing platform

13 NHS sites using the facilities

74 NHS sites with enhanced diagnostic equipment

118,263 Automated imaging reports

4 training programmes developed

1,641 Clinicians/researchers trained

12 Patient & Public Involvement & Engagement (PPIE) events

300 Patient & Public Involvement & Engagement (PPIE) participants

Follow-on R&D investment

£105,000
Follow-on investment from key industry partners

£250,000
Horizon Europe grant

£1.9m
National Institute for Health and Care Research (NIHR) funding to progress long COVID studies

Industrial Centre for Artificial Intelligence Research in Digital Diagnostics (ICAIRD)

Case Study

£11.6m

Challenge Fund investment

ICAIRD was led by the University of Glasgow and NHS Greater Glasgow and Clyde. The project involved the collaboration of 30 partners including 2 NHS Boards, 4 academic and 20 industry partners, including Canon Medical, Philips, Bering, and Kheiron Medical Technologies.

The project aimed to develop and deploy infrastructure to utilise AI in digital diagnostics, pathology and radiology, and led to the development of the Safe Haven Artificial Intelligence Platform (SHAIP) by Canon Medical which was deployed in the Glasgow and Aberdeen NHS safe-havens.

ICAIRD delivered 20 exemplar projects including the development of AI tools to improve stroke treatment, interpretation of chest X-ray, and development of a new decision support tool for breast cancer screening.

Additionally, the project supported the full digitisation of NHS Greater Glasgow and Clyde's digital pathology laboratories.

Impact

3 new data storage facilities

3 NHS sites with enhanced diagnostics equipment

3 million Digital pathology images collected

24 publications

77 UK events to promote projects

8 Overseas events to promote projects

41 Wider service users

20 exemplar projects

5 AI tools in development

2 AI tools validated

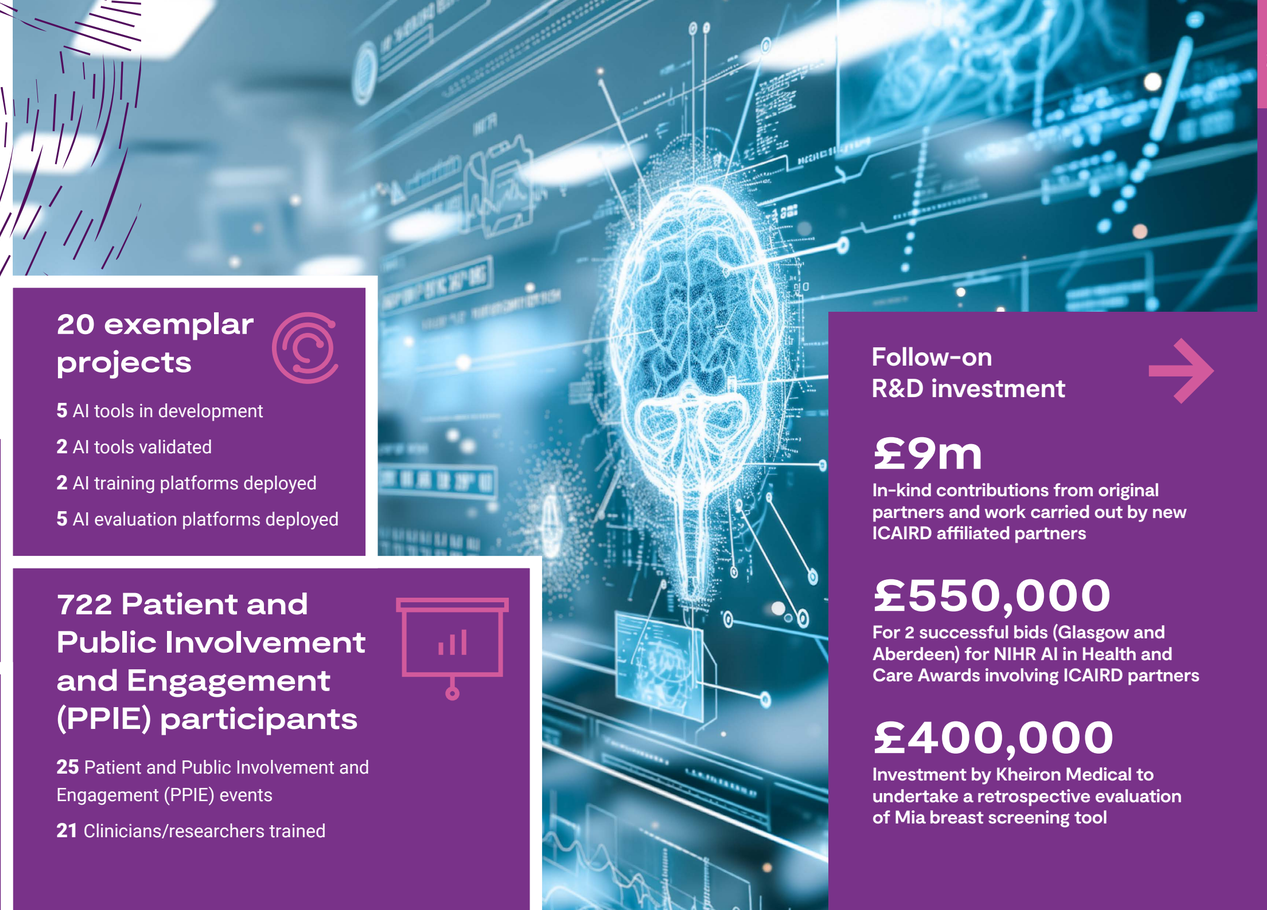
2 AI training platforms deployed

5 AI evaluation platforms deployed

722 Patient and Public Involvement and Engagement (PPIE) participants

25 Patient and Public Involvement and Engagement (PPIE) events

21 Clinicians/researchers trained



Follow-on R&D investment

£9m

In-kind contributions from original partners and work carried out by new ICAIRD affiliated partners

£550,000

For 2 successful bids (Glasgow and Aberdeen) for NIHR AI in Health and Care Awards involving ICAIRD partners

£400,000

Investment by Kheiron Medical to undertake a retrospective evaluation of Mia breast screening tool

Integrated Diagnostics (IDx)

£16m
Challenge Fund investment

£14.2m
Matched funding

The Challenge funded seven Integrated Diagnostics collaborative R&D projects to support the development of disruptive innovations that link technologies, data, care pathways and systems to create new diagnostic and precision medicine solutions.

The projects were:

- **ID Liver:** Integrated Diagnostics for Early Diagnosis of Liver Disease
- **iDx-LUNG:** Integrating non-invasive diagnostics into NHSE Lung Health Checks in Wessex and Yorkshire
- **ACTIONED Consortium:** integrAted moleCular soluTIons fOr diagNostics and Early Detection of colorectal cancer
- **DART:** The integration and analysis of data using artificial intelligence to improve patient outcomes with thoracic diseases
- **DELTA:** integrateD diagnostic solution for EarLy deTection of oesophageal cAncer
- **INCISE:** Integrated technologies for improved polyp surveillance
- **Quantitative reporting in Crohn's disease:** Maximising available MRI data to better direct patient treatment, speed up treatment decisions and improve healthcare outcome

IDx Lung: Lung Health Checks in Wessex and Yorkshire: Integrated Biomarker Studies

Case Study

£3.4m

Challenge Fund investment

Led by the University of Southampton with 12 partners, this project integrated new technologies in early cancer detection, specifically relating to CT scanning, with NHS Lung Health Check pilots in Wessex and Yorkshire. The project recruited 7,000 patients, providing 14,000 samples for clinical trials and created their own Secure Data Environment to integrate and analyse the data.

Impact

5,366 patients recruited

2 Patient and Public Involvement and Engagement (PPIE) events

5 publications by project partners

50 Academic industry collaborations linked to project activity

Follow-on R&D investment

£750,000

Follow-on investment from Cancer Research UK

Integrated Diagnostics for Early Detection of Liver Disease (ID Liver)

Case Study

£2.4m

Challenge Fund investment

ID Liver was led by the University of Manchester in collaboration with 14 partners. Liver disease predominantly starts to develop without clear symptoms and is often only detected at an advanced stage. The project ran seven mobile Liver Assessment Clinics, recruiting over 1,000 patients for participation in the associated clinical trial to evaluate new digital tools for earlier diagnosis.

Impact

1,195 patients recruited

- **1** AI diagnostic tool developed
- **2** New clinical pathways developed
- **7** Liver Assessment Clinics established
- **8** Patient and Public Involvement and Engagement (PPIE) events

5 publications

- **4** Academic industry collaborations linked to project activity

Follow-on R&D investment

£130,000
Additional in-kind funding from the NHS Trust and NIHR for the Research Van and patient community case finding

£100,000
Industry contribution - Echosens FibroScan device

£100,000
UKRI and NIHR funding for participatory research

£2m
Follow on investment from Health Innovation Manchester for the GM Advanced Diagnostics Accelerator - Liver Use Case

Digital Innovation Hub Programme

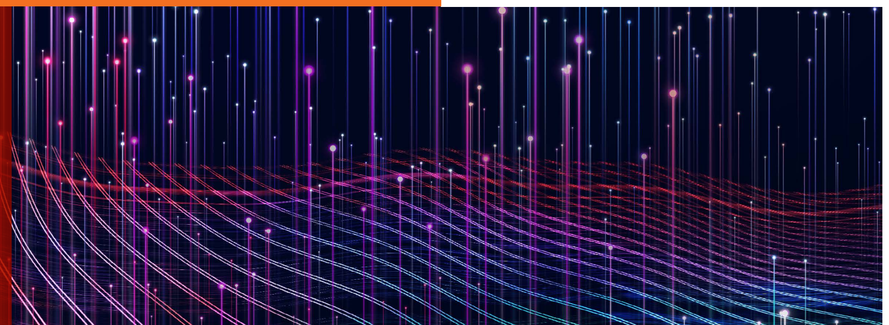
£41.7m
Challenge Fund investment

£34.5m
Direct co-investment

£336m
Follow-on investment

The Digital Innovation Hub Programme (DIHP), run in partnership with Health Data Research UK (HDR UK), collated routine NHS data with rich data from R&D programmes, providing analytics tools and data science support for businesses. The programme funded the development of UK-wide infrastructure for health data research and innovation, and was composed of the following three workstreams:

- Digital Innovation Hubs
- Health Data Research Innovation Gateway
- Health Data Research Alliance



Digital Innovation Hubs

£21.8m
Challenge Fund investment

£26.1m
Matched funding

The Challenge supported the creation of five Digital Innovation Hubs (BREATHE, DATA-CAN, INSIGHT, Discover-NOW and Gut Reaction) tasked with developing integrated, specialised, high quality data resources tailored to the needs of academic and commercial researchers.

These Hubs have provided a range of services including feasibility studies, analytics, consultancy, and clinical trial design, focusing on a range of disease areas including, eye, inflammatory bowel, cancer and respiratory diseases. Based on analysis by HDR UK, the Hubs have secured 200 academic and 175 commercial contracts.

HDR UK have built upon the model, subsequently expanding the network to include nine Hubs. These curate diverse datasets with an established consortium of NHS, academia, industry and charity organisations aligned to their objectives.

The five Hubs funded by the Challenge involved **49** partners (including **20** commercial partners), curating **149** datasets for major disease areas and delivering **138** Cancer R&D projects. To date, Hub partners have outputted a total of **163** publications.

Digital Innovation Hub – INSIGHT: Eye Health

Case Study

£2.4m

Challenge Fund investment

INSIGHT are an NHS-led initiative established to make routinely collected data available for approved health research. This Hub, a collaboration between Moorfields Eye Hospital NHS Foundation Trust and University Hospitals Birmingham NHS Foundation Trust, aims to enhance healthcare accessibility by facilitating researcher access to large, anonymised patient datasets in a secure and ethical manner.

INSIGHT is a first-of-its kind resource that allows researchers to access anonymised, curated imaging datasets related to eye disease. The ocular database includes large-scale collections of patient-centred data, ophthalmic imaging, electrodiagnostics, visual fields and other clinical data.

INSIGHT's data offering includes various types of eye imaging and associated patient health records. Using advanced analytics, such as AI, INSIGHT allows researchers to develop new insights in disease detection, diagnosis, treatments and personalised healthcare.

Impact

13 platinum rated datasets available through innovation gateway

More than **27 million** high quality retinal images

2.2 Million patients represented

3 Publications

211 Research projects

Digital Innovation Hub – Gut Reaction – Inflammatory Bowel Disease (IBD) Data Resource

Case Study

£2.4m

Challenge Fund investment

Gut Reaction is a unique, secure data resource designed to facilitate academic and industry research in IBD. The Hub works with the IBD community to improve treatment options and patient outcomes through safe, transparent and responsible use of patient data.

The Hub features a consented collection of data from around 36,000 participants with IBD, including health and lifestyle questionnaires, linked health records, genetics, and biological samples.

Impact

12 datasets available through innovation gateway

10 publications

Health Data Research Innovation Gateway

£8.1m

Challenge Fund investment

The Health Data Research Innovation Gateway, launched in 2020, provides a portal for researchers to search, discover and request access to health datasets in the UK. Its core services enable users to explore, manage, enhance and request access to health data, tools and other resources vital for research.

Already, the metadata from **843** datasets across more than **70** data custodians have been made discoverable on the Gateway, with **3,419** registered users of the platform from across the health data community. Additionally, **1,138** data uses have been uploaded to the Gateway register in line with standards developed by the UK Health Data Research Alliance.

The Gateway, a key component of Health Data Research UK's new technology strategy, is now being developed in collaboration with NHS England's Data for R&D programme as the 'single front door' for the NHS Research Secure Data Environment Network. It will evolve to provide users with a clear and consistent journey for data and cohort discovery, reducing complexity and confusion for researchers needing secure access to data.

The Gateway was built and developed in a step-wise process, building on functionality to support data access.

Since the launch of the Innovation Gateway Minimum in May 2020 the Gateway has received the following enhancements:

- The implementation of a Data Utility Framework
- Incorporation of the 'Five Safes' (safe people, data, projects, settings and outputs) to the data access request form
- Enhancements to meta data, feedback mechanisms, and advanced filtering options
- The ability to search across multiple datasets based on specific demographic characteristics

Health Data Research Alliance

£1.2m

Challenge Fund investment

Initially established in 2019 with only eight member organisations, the UK Health Data Research Alliance aims to improve access to health data.

The Alliance sets out its commitment to collaborative working in a 'Principles of Participation'. These principles reinforce the importance of the Five Safes Framework, ensuring that data is FAIR (findable, accessible, interoperable and reusable), users contribute to the Gateway, innovation, and the development of public trust around data.

The Alliance brought together key health data controllers, a range of government bodies, NHS teams and organisations, public sector, charities and industry partners. It is a forum to develop tools, standards and specifications for data interoperability and information governance processes. It runs consultations on principles and best practice and helps to shape the field by publishing both green and white papers.

The membership has since grown to almost 100, with a target of 200 members by 2025.

Further Information

Genomics

UK Biobank

Genomics England

Health Data

Health Data Research UK

UK Health Data Research Alliance

Health Data Research Innovation Gateway

Digital Innovation Hubs

BREATHE – Health Data Research Hub for Respiratory Health

DATA-CAN – Health Data Research Hub for Cancer

Discover-NOW – Health Data Research Hub for Real World Evidence

Gut-Reaction – Health Data Research Hub for Inflammatory Bowel Disease

INSIGHT – Health Data Research Hub for Eye Health

Centres of Excellence

Industrial Centre for Artificial Intelligence Research in Digital Diagnostics

London Medical Imaging and AI Centre for Value-Based Healthcare

Pathology Image Data Lake for Analytics, Knowledge and Education

National Consortium of Intelligent Medical Imaging

National Pathology Imaging Co-operative

Integrated Diagnostics Programme Projects

ID Liver: Integrated Diagnostics for Early Diagnosis of Liver Disease

iDx-LUNG: Integrating non-invasive diagnostics into NHSE Lung Health Checks in Wessex and Yorkshire

ACTIONED Consortium: integrAted moleCular soluTIons fOr diagNostics and Early Detection

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DELTA: integrateD diagnostic solution for EarLy deTection of oesophageal cAncer

INCISE: Integrated Technologies for Improved Polyp Surveillance

Quantitative Reporting in Crohn's Disease

Delivered by Innovate UK and MRC

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