Creating a national Genomic Medicine Service

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Into the next generation – science moving beyond genomics alone

Profound scientific & technological innovation influencing NHS transformation and effectiveness; as outlined in 5 Year Forward View and the next steps in implementation
100,000 Genomes: a world-leading foundation for healthcare transformation

Key principles underpin the Project and the NHS contribution:

- **WGS extends** current NHS funded diagnostic repertoire
- Recruitment of patients with Cancer and Rare Disease from routine care
- **Participants consent** to sharing of de identified data for R and D and for access to longitudinal records
- Moving from proof of concept to implementation in 3 years and aligned to **two major system priorities** *(UK Rare Disease strategy and Cancer Taskforce)*
- **A model for transformational change** in the NHS as well as delivering science and partnerships with industry

**100,000 Genomes – the major legacy**

- Increased discovery of new pathogenic variants
- Integrating advanced genomics into mainstream NHS
- Raising awareness & engagement of use of genomic data
- Building in knowledge, pathway & approaches to core care of the future
- Stimulating and advancing UK life sciences industry
- New collaborative partnerships

**Increased public understanding & support**

**Leading to new diagnoses & treatments, devices & diagnostics**
The service infrastructure: NHS Genomic Medicine Centres

- Coordinating care for populations of ~3-7 million, responsible for pathways & services across their geography.
- Lead organisation builds networks with other trusts as Local Delivery Partners (over 90 Trusts will be involved at completion of Project)
- Provide transformative leadership to the system – with a significant contribution from genetic lab services – including as Clinical Programme Leads
- Capture improvements in clinical outcomes and drive change in clinical utility
- Underpinned by HEE Genomics Education Programme and investment in genetic scientists and bioinformatics
Enhanced referral processes

Involvement of broad range of clinical specialities & teams

New ways of working with patient groups

Distributed clinical leadership and new approaches to clinical engagement

Establishment of Rare disease & Cancer Genomic MDTs

Improved phenotypic characterisation of patients

Clinical Transformation
Huge advances have been made across informatics to support the delivery of genomic medicine. This includes:

- Developing new protocols & pathways to maximise the quality of DNA extracted & quality of sequence
- Coordinating & process Multiomic samples including cfDNA
- Establish national & local lab local networks to standardise working practices inclusive of pathology & collation of data
- Robust External Quality Assurance driving improvements in practice & consolidation of approach around best practice
- Validation & feedback of tiered variants & standardisation of reporting
- Involvement & contribution to genomic multi-disciplinary teams in both rare disease & cancer
Informatics transformation

Huge advances have been made across informatics to support the delivery of genomic medicine. This includes:

- Increasing connectivity & interoperability between laboratory & hospital systems & creation of ‘data hubs’
- Increasing digital imaging capacity & capability
- Automated sample handling & tracking across pathology & genetics using global GS1 standards
- Hardware & software solutions to support recruitment staff and virtual MDTs.
- Standardised approach to data description & collection inc SNOMED-CT & HPO
- Supporting staff upskilling, training & development
How the elements of the Project fit together

Registry (PHE)
HES (HSCIC)
Other NHS Clinical Data

NHS Genome Medicine Centres

Biobank sample

Phenotype
DNA
BAM/VCF

Sequencing (Illumina)

Genomics England
Clinical Interpretation Partnership (GeCIP)

GeCIP/GENE Embassies
Data Centre
Clinical Interpretation Services

GENE Consortium

NGS

NHS Firewall

Consent

Contract

Contract

Contract

Contract

Consent

Clinical Report

Clinical Report

DNA

Grants

Grants

Grants

Grants

Genome Interpretation Service Companies

NHS Firewall

How the elements of the Project fit together
Genomic Medicine: a focus around the world for personalisation

Countries across the globe – in both developed & developing world – are conducting a range of genomic medicine initiatives, recognising the importance of this technology to future healthcare. This diagram shows some of the initiatives taking place.
Why the NHS? Why now?

A proud heritage of UK genetic advance has triggered development of organisations and policy initiatives over the years - real appetite for 100,000 Genomes Project and its legacy in an NHS Genomic Medicine Service delivering personalisation for patients.

Long term investment by Gov’t in genetic services & workforce

NHS Genetic Labs working since the 60s

>£600 million investment in 100,000 Genomes Project & NHS contribution

Major parliamentary reports setting out strategic direction

Building on our Inheritance – HGSG (2012)
Biomedical science and the UK Industrial Strategy

Investing in science, research and innovation

“Innovation is not just about a few people in labs making breakthroughs, but about adopting new and more productive ways of working.

“To become a more innovative economy requires the ability to seize new opportunities and adapt to change.

“The United Kingdom has the advantage of a strong science base – including more Nobel Laureates than any country outside the United States.”

Building our Industrial Strategy
HM Government, Jan 2017

We ask NHS England to promote and support participation by NHS organisations and patients in research funded both by commercial and non-commercial organisations.
Gov’t Mandate to NHS England 2016-7
Delivering genomic-based personalisation for patient benefit & service sustainability

- Technology available and affordable
- Patients/Public ready for change
- Clinical Leadership & workforce upskilling
- Proof of concept for routine care established
- New service networks and patient pathways set up
- Health economics established
- System planning & commissioning aligned

Transformed pathways of care based on careful characterisation of patients facilitating tailored interventions

GENOMIC MEDICINE FOR PERSONALISATION

Spectrum of delivery
At home
Specialist Care
Moving forward – activity to deliver personalisation

Improving Outcomes through Personalised Medicine (Sep 2016) sets out a 10-year framework for the delivery of personalised medicine across the NHS, including:

- improved prediction & prevention based on underlying predisposition
- more precise (and prompt) diagnosis based on cause
- targeted interventions through the use of companion diagnostics to identify & personalise effective treatments
- better use of diagnostic spend to provide objectivity to medicines use

Key activity from national partners:

- Build the commissioning, data & informatics infrastructure
- Roll out personalised medicine approach in a number of clinical areas, linked to NHS England’s priorities & informed by AMS exemplar pathways
- Engage & involve the public, patients & patient groups, clinicians, academics, industry & others to inform and shape the approach
- Develop the enabling framework to ensure that personalised medicine approaches are proactively adopted based on strong evidence, value & ethics

Multilevel approach to personalisation in respiratory conditions

- Respiratory conditions are increasingly recognised as having a range of heterogeneous phenotypes making them ideal candidates for a personalised approach at many levels, such as through Agusti’s network model for COPD (Thorax, 2014)
Transforming the patient pathway

- Precise diagnosis – precise treatment selection - Fewer non-responders/ADRs
- Greater multi-professional involvement in MDT
- Role for community-based diagnostics/screening
- Working across the care continuum, moving burden of disease from late stage care to early identification & diagnosis
A whole pathway approach to developing personalisation across care continuum

Evaluation of candidate conditions assesses:
- Potential for **high impact** of next-generation diagnostics including functional genomics and for **medicines optimisation**
- Evidence base for **utility/cost effectiveness** and health economics
- Responsiveness & turnaround time for results
- Evolution of **Informatics and analytical platforms** including decision support
- Whole pathway approach
- Adoption of new technologies

**NHS Clinical priorities**
- Diabetes
- Mental health

**Opportunities for population health approaches**
- Familial Hypercholesterolemia

**Medicines optimisation & reduction of ADR**
- Warfarin
- Respiratory

**Where significant utility from next-gen diagnostic approaches**
- Rare Diseases, Cancer

**Where significant variation in access**
- Renal
- Cardiovascular

NHS Genomic Medicine Service: Our aim

A national genomic medicine service driving personalised treatments and interventions with consistent & equitable access across the country

Focus on improving quality and reducing variability, setting standards and driving consistency, economies of scale and affordability

New NHS England governance and accountability and linked to an NHS England and Genomics England partnership
Birth of the NHS Genomic Medicine Service

Mar 2017: NHS England Board agrees strategic approach for building a genomic medicine service from 2018/19, delivering personalisation of treatment and intervention building on the legacy of the 100,000 Genomes Project.

The key principles for the NHS genomic medicine service are:

- To ensure **comprehensive and equitable access** for the entire population
- To improve the **quality, value and sustainability** of care by providing prompt diagnosis and personalised care
- To support **learning, research & development** through new collaborative partnerships between the NHS and with academia and UK life science sector and international collaborators.
- To **retain and build the political, ethical and moral trust** of the UK in genomic medicine
Assembling all the building blocks

National Genomic Medicine Service underpinning Personalised treatments and interventions

- Genomic Medicine Centres providing population-based care
- Informatics architecture & data store
- Workforce development inc upskilling of existing staff
- National Lab Network inc Genomic Laboratory Hubs
- Whole Genome Sequencing Provider
- Clinical Interpretation Pipeline
- National Testing Strategy from single gene - WGS
- Industry/ academic/ international partnerships supporting ongoing research & development through clinical care

Advances in genomic and informatics technologies and in other next generation diagnostics
Evolution of NHS GMCs

Key role in driving change across the NHS

- Ensuring **comprehensive coverage** and access across their geography, including all NHS Acute Trusts, Specialist Providers and Primary Care
- Enabling **access to an approved genomic test directory** up to level of WGS and consolidate learning from 100,000 Genomes Project
- Delivering national **genomic medicine service consent** model
- **Integrating clinical genetics service** to provide advice and expertise
- **Further mainstreaming** Genomics outside of clinical genetics and embedding within other clinical specialities to introduce genomic testing within a broader range of conditions and pathways
- Further evolution and establishment of **genomic MDTs** to cover geographies
- Further **informatics and data developments** to underpin delivery
- **Driving medicines optimisation/ appropriate prescribing and personalisation of interventions**
A comprehensive genomic testing strategy

• To ensure that all of the genomic tests available within the NHS are the most clinically and cost effective, and provided by the most appropriate organisation
• Ongoing response to technological advances/ decommissioning of superseded tests
• Aligned to workforce improvements and establishment of overall genomic medicine service
• Informed by Expert Transformation Groups
  — Objective criteria & metrics eg outcomes, quality, VfM
  — Methodology for testing modalities – eg single gene/ panel/ WGS
  — Developed and tested in clinical priority areas eg maternal & child health, mental health, neurological, cardiovascular, metabolic medicine
Delivering the genetic testing strategy

- Testing strategy = mandated policy framework + directory of tests

Iterative and ongoing process to identify tests & determine clinical utility

Wet genes/arrays/panels/exomes

TRANSFORMATION

WGS + informatics genes/panels/exomes + biomarkers

Note: WGS provides extra diagnostic reach (structural variants, copy no. variants etc)
The right test in the right place at the right time

A 360º view of current genetic testing

- Definitive test list for rare disease & cancer
- Evidence based framework for initial list & annual review
- WGS & functional tests & replacement of existing tests
- Baseline commissioning & money flows & funding & economic model
- Service specification & informatics & data sharing model
- Governance & monitoring arrangements
The new laboratory infrastructure

Each GLH will:
- Deliver a mandated lists of genomic tests with external access to WGS
- Provide services across a defined geography
- Have formal contractual arrangements with other labs in their patch – reviewing opportunities for further consolidation as technology permits
- Operate as part of a national network and locally with affiliated labs
Key responsibilities of GLHs

- Consolidate services
- Operate within a national network
- Operate a coherent informatics infrastructure
- Deliver and assure operation to national standards
- Coordinate governance & contracts across their geography
- Coordinate finance, budget & commissioned activity
- Build formal interfaces with national bodies, local NHS GMCs, other clinical teams & industry
- Plan & develop workforce for now and the future
- Secure scientific expertise to deliver cutting-edge technology & generate evidence to inform practice
# Overall timeline –

<table>
<thead>
<tr>
<th>Date</th>
<th>Detail</th>
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<tbody>
<tr>
<td>June ‘17</td>
<td>Issue PIN notice listing the key requirements for the future infrastructure</td>
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<tr>
<td>July ‘17</td>
<td>Market Engagement Events</td>
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<tr>
<td>August ‘17</td>
<td>Bilateral discussions with potential bidders</td>
</tr>
<tr>
<td>September ‘17</td>
<td>Issue draft specification – discussion with potential bidders</td>
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<tr>
<td>October ‘17</td>
<td>Discussion with potential bidders</td>
</tr>
<tr>
<td>November ‘17</td>
<td>Issue formal ITT</td>
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<tr>
<td>February ‘18</td>
<td>Deadline for Final Bids &amp; shortlisting</td>
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<tr>
<td>March ‘18</td>
<td>Panel assessments &amp; contract award</td>
</tr>
<tr>
<td>April – October ‘18</td>
<td>Mobilisation</td>
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- Final approval for overall genomic medicine service: September ‘17
- Agreement on WGS volumes: September’17
- Final agreement on mandated genomic testing list: October’ 17
Building the service

A comprehensive genomic testing strategy
• Encompassing single genes & markers to WGS
• Joint commissioning for cancer molecular testing and (where appropriate) inherited disease

new genomic laboratory hubs

commitment to support UK Genomic knowledge base (for research and industry collaboration)

data warehouse for all NHS Genomic data

clinical interpretation pipeline for WGS
Alignment & partnership driving research advance, future care & innovation

NHS Genomic Medicine plans structured to actively engage & support research endeavours by clinicians, academia & the life science industry for patient benefit.

This includes:

- Providing an evidence base to inform identification of new treatment targets & approaches
- Analysis of evidence base to improve understanding of conditions & their heterogeneity
- Supporting trial design & patient selection
- Repurposing of existing drugs & treatment
- Better tests for clinicians to check patients for suitability; Patients more confident in fit of medicine - benefits for adherence, support & monitoring
- Mining data for findings that boost understanding of real world response
The personalisation journey over the next decade

**Today:**
- ‘One-size-fits-all’ treatment based on symptoms
- Services and professions organised according to organ/speciality
- Limited use of genomic and molecular markers
- Diagnostic and clinical data not linked

**By 2020:**
- Whole genome sequencing for specific conditions
- Improved diagnosis of rare conditions and better understanding of cancer
- Comprehensive, linked diagnostic data coupled with effective informatics analysis to give a full picture of patients

**By 2025:**
- New taxonomy of medicine based on underlying cause and personal response
- Integrated clinical services taking a ‘whole body’ approach
- Tailored, optimised and more effective therapies for better outcomes
- New NHS relationships with academia, industry, patients & patient groups