The 100,000 Genomes Project: Paving the Way for Personalised Medicine

Dr Tom Fowler, Deputy Chief Scientist, Genomics England
THE FIRST HUMAN GENOME SEQUENCE

• 26th June 2000 - Cost $3.2 billion
• 100,000 Genomes at Millennium Prices - Cost $320 trillion
COST PER MILLION BASES OF SEQUENCING
THE 100,000 GENOMES PROJECT IN NUMBERS

100,000 genomes

70,000 patients and family members

21 Petabytes of data.
1 Petabyte of music would take 2,000 years to play on an MP3 player.

13 Genomic Medicine Centres, and
85 NHS Trusts within them are involved in recruiting participants

1,500 NHS staff
(doctors, nurses, pathologists, laboratory staff, genetic counsellors)

2,500 researchers and trainees from around the world
100,000 GENOMES PROJECT

• Announced by the Prime Minister in 2012 – an Olympic legacy
• Sequencing 100,000 genomes
• Participants are NHS patients with a rare disease, plus their families, and patients with cancer.
• Infectious Diseases lead by Public Health England
• Four main aims

1. Bring benefit to NHS patients
2. Ethical and transparent programme based on consent
3. Enable new scientific discovery and medical insights
4. Kick-start the development of a UK genomics industry
A CO-ORDINATED RESPONSE ACROSS HEALTH AND CARE

- Co-ordinating genomic knowledge to make the UK a world leader
- Sequencing 100,000 genomes to advance genomic knowledge
- Turning genomic knowledge into health interventions
- Ensuring the NHS Workforce is skilled and able to deliver for patient benefit
- Using genomic knowledge for prevention and health protection
HOW IT WORKS

• 13 Genomic Medicine Centres covering England
• Responsible for identifying and recruiting participants and for clinical care following results
COLLATED DATA PLAN

Life course data “additional”

NHS datasets:
- Commissioning
- Clinical
- Central return
- Supporting
- Disease registries
- Screening services
- National clinical audits

Genomic Results
- Interpretation
- Clinical application
- Germline
- Somatic

GMC clinical baseline “core”
- Sample metadata
- Diseases
- Assessments (staging, HPO)
- Lab test results
- Pedigree

GMC registration “essential”
- Demographics
- Consent status
- Additional findings
- Registration
- Sample processing

12 May 2017
GENOMICS ENGLAND CLINICAL INTERPRETATION PARTNERSHIP (GECIP)

• Launched at the Wellcome Trust in June 2014
• Partnership between over 2,000 researchers from academia and the NHS, trainees, plus international collaborators.
• Designed to accelerate academic/industry partnership and development of diagnostics and therapies
• 40 topics (domains) of research established. Most cover a single disease or group of diseases and some are wider e.g. epigenomics, health economics and technology.
• All data generated contributes to the Genomics England Dataset
GENE CONSORTIUM

• 13 companies = the Genomics Expert Network for Enterprises (GENE) Consortium to oversee a year-long Industry Trial

• Aims to identify most effective and secure way to accelerate development of new diagnostics and treatments for patients

• Range from big pharma to small biotech

• Working in a pre-competitive environment

AbbVie, Alexion, AstraZeneca, Berg, Biogen, Dimension Therapeutics, GSK, Helomics, Roche, Takeda, NGM Biopharmaceuticals, UCB, Intellia Therapeutics
WHAT ARE WE TELLING PARTICIPANTS?

- Information about a patient’s main condition

- Information about additional ‘serious and actionable’ conditions (optional)

- Carrier status for non affected parents of children with rare disease (optional)
NEW ERA OF PERSONALISED MEDICINE

THE 4 Ps:

1. **Prediction** and **prevention** of disease
2. More **precise** diagnosis
3. Targeted and **personalised** interventions
4. A more **participatory** role for patients
Improving outcomes through personalisation

- **Improves outcomes**
  - **Targeted therapy**
    - Identification of effective personalised treatments
  - **Accelerated diagnosis**
    - Based on underlying cause and incidental findings – rather than just grouped symptoms
  - **Early disease detection**
    - 2-8 yrs before onset & symptoms become obvious with low cost stratification
  - **Targeted disease prevention**
    - Identification of predisposition markers or underlying processes can predict future disease
The strategic approach -
tailoring treatment & management to a patient’s individual makeup

Now

• ‘One size fits all’ treatment based on symptoms
• Organ/ speciality organisation of services and professions
• Limited use of genomic and molecular markers
• Diagnostic and other clinical data not linked

2020

• New taxonomy of medicine based on underlying cause and personal response
• Comprehensive linked diagnostics to give a full picture of patient
• Tailored, more-effective therapies for better outcomes
• Integrated clinical services taking a ‘whole body’ approach

‘One size fits all’ treatments & intervention

Individually-tailored approach

Increasingly precision interventions based upon carefully identified subgroups within the broader population

https://www.england.nhs.uk/ourwork/qual-clin-lead/personalisedmedicine/
Shaping healthcare through a wealth of new information
Genomic diagnosis guides clinical management in neonatal diabetes

**MODY** (maturity-onset diabetes of the young)
- Another more common, form of monogenic diabetes
- Patients have higher fasting blood glucose which is regulated around a stable set point and so often misdiagnosed with T1D or type 2 diabetes
- Often identified during routine antenatal screening and misdiagnosed as gestational diabetes
- No treatment required - stopping therapy reduces costs and improves quality of care
- Stratified approach to MODY is highly important with new tools available to support implementation e.g. DNA sequencing technology - allow a single test to be used for all known genetic subtypes

*Exemplar clinical pathways for a stratified approach to diabetes, Sep 2016, Academy of Med Sciences*
First families diagnosed from the Newcastle BioResource pilot

Leslie Hedley, 57

WGS revealed Mr Hedley’s kidney failure was caused by a particular genetic variant (INF2 mutation). His family is also being tested and their blood pressure can now be effectively controlled by drugs available on the NHS.

Genomes project produces first diagnoses of rare diseases

British first in health care tailored to genes
PATIENT VS PUBLIC VIEWS

THE GENOMICS CONVERSATION
Survey Results
Prepared by Genetic Alliance UK
September 2016

Genome sequencing: What do patients think?
Patient Charter

FINANCIAL TIMES

Fears raised over Google’s DeepMind deal to use NHS medical data
Academics concerned over company’s access to private records for mobile app

Revealed: Google AI has access to huge haul of NHS patient data
A data-sharing agreement obtained by New Scientist shows that Google DeepMind’s collaboration with the NHS goes far beyond what it has publicly announced

@eHealthWeekEU #eHealthWeek
PATIENT AND PUBLIC INVOLVEMENT (PPI)

- **PPI groups** within each GMC contribute to the project.

- **Participant Panel** advises Genomics England - its members also sit on committees e.g. Data Access Review Committee, Ethics Advisory, GeCIP Board
LATEST FIGURES

http://www.genomicsengland.co.uk/updates

• As of May 2017, we have now sequenced over 20,000 whole genomes from patients and their families.

• A semi-automated reporting pipeline has been built, and results are now being returned to the NHS.
Stay in touch

We need 10k more followers to match our WGS!

@genomicsengland #genomes100k

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Join our team

Opportunities in:
• Bioinformatics
• Software Development
• Data Analysis
• Project management
• Clinical and scientific support
• Admin
• & others

www.genomicsengland.co.uk/about-genomics-england/opportunities
With thanks to..

- Chief Scientific Officer for NHS England, Prof Sue Hill
- PHG Foundation
- Academy of Medical Sciences
Thank you!

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