England’s Genomics Education Programme for NHS Healthcare professionals

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Chief Scientific Officer for England

www.hee.nhs.uk
Science & innovation provides the revolutionary change health needs

- Throughout its existence, the NHS has turned to scientific innovation to provide the step-change in practice required to keep pace with patient needs and service demands
- Genomics builds on the long history of discovery and advance in the UK

1859: Darwin – Origin of Species
1951: Watson & Crick
1974: Sanger – DNA sequencing
1984: Alec Jeffreys – DNA fingerprinting
1997: Dennis Lo – cfDNA NIPT

UK has fostered more than twice as many Nobel prizes for Medicine & Physiology per capita than anywhere else in the world.

The NHS has had specialist genetic labs since the 1960s, with Next Generation Sequencing capability & UK Genetic Testing network - sponsored by NHS England - coordinating role for approval of tests/panels

PLUS firsts in:
- Diagnostic ultrasound
- CT scanning
- IVF & PGD
Aims & principles of the 100,000 Genomes Project

In 2012 Prime Minister launches 100,000 Genomes Project made possible due to the decreasing cost of sequencing and developments in computational power and data analytics

“By unlocking the power of DNA data, the NHS will lead the global race for better tests, better drugs and above all better care.

Major legacies for patients, the NHS and the UK economy by 2017

- Increased discovery of pathogenic variants leading to new treatments, devices and diagnostics
- Accelerate uptake with advanced genomic medicine practice integrated into the NHS
- Increase public understanding & support for genomic medicine
- Stimulate and advance UK life sciences industry and commercial activity in genomics

Key Principles

1. A focus on rare inherited diseases and common cancers
2. Patients to be drawn from routine care and treated through routine channels
3. All participants to provide a fully informed consent providing for a wide range of data and tissue capture and broad categories of use including research and industry
4. However neither data nor tissues to go outside NHS-controlled ‘safe havens’ and all users to be properly authorised and monitored
5. A separate (government owned) company – Genomics England – formed to coordinate the project under an independent board, providing a ‘start-up’ mentality and drive

Whole genome sequencing is providing a step change in the NHS diagnostic repertoire
100,000 Genomes Project - A coordinated response across England’s health & care system

Long-term vision for NHS
- Improving outcomes for patients via better, more precise diagnoses, particularly in cancer & rare disease
- Providing the foundation for an NHS Personalised Medicine Service

Using genomic knowledge for prevention and health protection

Co-ordinating genomic knowledge to make the UK a world leader

Sequencing 100,000 genomes to advance genomic knowledge

Ensuring the NHS Workforce is skilled and able to deliver for patient benefit

Turning genomic knowledge into health interventions
Project delivery infrastructure

- Nationwide network of 13 NHS Genomic Medicine Centres – each lead organisation having partnerships with local hospitals as delivery partners
- National network of 10 universities providing staff training through HEE Genomics Education Programme
- Clinical Interpretation Partnerships (GeCIP) integrate with researchers to drive advance
- Genomics England coordinates national partners & initiatives:
  - National Sequencing Centre
  - Biorepository
  - Data centre
  - Interpretation partners
  - Industry & academic collaborations
Involvement of multiple clinical specialities in new MDTs

Step change in analysis of information, validation & reporting

Capture of data from multiple systems against defined datasets and standards

Sample collection, processing & logistics to defined protocols & quality standards

Return of results to participants & clinical care according to guidelines

Key roles of NHS GMCs

Partnerships & networks working across geographies

Upskilling the NHS Workforce

Patient & Public Involvement

Transforming the NHS – improving outcomes & reducing variation

Patient & Public Involvement
How the elements of the Project fit together

13 NHS Genomic Medicine Centres working in a national network
- Clinical samples and patient data (diagnostic and clinical)
- Laboratory processing including molecular pathology
- Broad consent for research and re-contact
- Validation and feedback to participants/clinical teams

Participants
- NHS England

Biorepository
- DNA & samples for multi-omics

Sequencing
- Illumina

Clinical Data
- Identifiable clinical data
- Longitudinal
- Linked to genomic data

Research Data
- Deidentified
- GeCIP and industry partners work within data centre

Existing Clinical Data
- Cancer & RD registries, HES, Mortality data, etc

Data and Analysis Improvement
- Annotation & QC
- Scientists/SMEs
- Product comparison

Fire wall

Other countries of UK and other international collaborators working to specification set down by NHS England
# Clinical interpretation - GeCIP

Partnerships between healthcare professionals, academia and charities
39 different domains, 100+ subdomains

<table>
<thead>
<tr>
<th>Rare Disease (n=13)</th>
<th>Cancer (n=15)</th>
<th>Functional (n=11)</th>
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</thead>
<tbody>
<tr>
<td>Cardiovascular</td>
<td>Adult Glioma</td>
<td>Electronic Health Records</td>
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<td>Endocrine and Metabolism</td>
<td>Breast</td>
<td>Validation and Feedback</td>
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<tr>
<td>Gastroenterology and Hepatology</td>
<td>Colorectal</td>
<td>Ethics and Social Science</td>
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<td>Hearing and Sight</td>
<td>Upper GI</td>
<td>Functional Effects</td>
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<td>Immunology and Haematology</td>
<td>Lung</td>
<td>Health Economics</td>
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<td>Inherited Cancer Predisposition</td>
<td>Melanoma</td>
<td>Machine Learning, Quantitative Methods and Functional Genomics</td>
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<tr>
<td>Musculoskeletal</td>
<td>Renal Cell &amp; Bladder</td>
<td>Population Genomics</td>
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<tr>
<td>Neurological</td>
<td>Sarcoma</td>
<td>Enabling Rare Disease Translational Genomics via Advanced Analytics and International Interoperability</td>
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<tr>
<td>Paediatric Sepsis</td>
<td>Testis</td>
<td>Functional Cross Cutting</td>
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<td>Paediatrics</td>
<td>Ovarian (incl endometrial)</td>
<td>Education and Training</td>
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<tr>
<td>Renal</td>
<td>Lung</td>
<td>Stratified Medicine &amp; Pharmacogenomics</td>
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<tr>
<td>Respiratory</td>
<td>Melanoma</td>
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<td>Skin</td>
<td>Renal Cell &amp; Bladder</td>
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<td>Prostate</td>
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<td>Childhood Solid Cancers</td>
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<td></td>
<td>Haematological Malignancy</td>
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<td></td>
<td>Pan Cancer</td>
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HEE Genomics Education Programme

Strategy and Aims

• Embed genomics into education: current & future healthcare workforce

• Integrate whole-genome sequencing (WGS) & functional genomics into mainstream care - benefit patients & the public

• Build capacity & capability - world-leading response to the genomic medicine revolution

• Legacy of the 100,000 Genomes Project – embedded in the healthcare system & wider economic contribution
Supporting workforce transformation across the NHS

Highly Specialised workforce
- clinical and laboratory genetics, molecular pathology, molecular haematology, bioinformatics

Specialist clinical workforce
- oncology, haematology, metabolic medicine, cardiovascular medicine

General workforce
- general practice, all healthcare professionals

Wider awareness raising
- including managers & commissioners, patients and public
Planning for the future

• The great challenge is to anticipate the mix of skills, experience and abilities that will be needed to deliver future services

• It takes >11-15 years to train to be a senior nurse, scientist or doctor – so we need to be planning now for 10-15 years’ time

• Need to anticipate and prepare for what new technologies will emerge & what will be consigned to history – building the flexibility into individual’s training to allow them respond to future developments

• Key aspect is to upskill existing staff to allow rapid harnessing of emergent technologies for patient benefit
Mainstreaming genomic education & training

• As genomic medicine becomes a standard part of mainstream NHS practice, so the corresponding education and training will become integrated within the core planning and activity of HEE through its delivery structure

• The Genomics Education Programme exists to establish the systems, processes and core resources – but is time limited

• Programme activity involves close engagement with local education & training and their corresponding NHS GMC(s) to prepare to deliver this activity as part of their ongoing work
Mind the gap…

- Key aspect of GEP is to identify interventions to address gaps in knowledge, skills and competencies for the delivery of current and future care

- Close working with professional bodies and organisations:
  - Council of Medical Deans - undergraduate medical curricula
  - Medical Royal Colleges (eg RC Physicians, RC General Practice) - Postgrad curricula and CPD
  - National School of Healthcare Science – all postgrad curricula have genomics element, all doctoral curricula have a specific genomic competence
GEP resources to directly support the 100,000 Genomes project

- Bespoke multiprofessional online on-demand short courses tailored to give staff specific skills for each step of the project pathway
- Development follows the pipeline. Early courses include:
  - Consent conversation
  - Sample Processing
- In development:
  - Tumour Assessment Training Tool
  - Validation & Feedback
  - Data governance & security

• Eligible patients
• Phenotypic data sets
• Sample collection & processing
• Sequencing
• Validation of collected data
• Clinical report and action
Building Capacity and Capability

- New postgraduate curricula for Healthcare professionals
- Multiprofessional Master’s in Genomic Medicine
- Pump priming additional training places

- **PLUS** Resource development to support the move to more Personalised Medicine across the NHS
Capacity and Capability
New Curricula for Healthcare Scientists

Aligned to national healthcare scientist training pathway

Clinical Scientists in Genomic Sciences
- Genomics (2016)
- Genomic Counselling (2016)
- Molecular Pathology (2017)

Clinical Bioinformatics
- Genomics
- Physical Sciences
- Health Informatics
Clinical Bioinformatics
Establishing a new profession

2013
• Curriculum for STP training in Clinical Bioinformatics
• Competence based workplace training
• Academic Master’s
• Three cohorts: first cohort of 8 trainees to exit in Sept 2016
• Registration with Health Care Professions Council
• Equivalence process established

2015
• Published HEE report on Developing Clinical Bioinformatics
• Developed Bioinformatics Modules in the national Genomic Medicine Master’s

2016
• Curriculum for HSST training in Clinical Bioinformatics
• Academic Doctoral level – HEI currently under procurement
• Competence workplace based assessment
• HEE GEP funded 12 places starting October 2016
The Master’s in Genomic Medicine

- Masters 550 funded places
- PGDip
- PGCert
- CPPD 900 funded places

Network of 10 HEI providers

“The Master’s will help prepare NHS staff for the future of genomics in contemporary healthcare”

www.genomicseducation.hee.nhs.uk/genomicsmsc/
Providing modules to support staff across the breadth of genomic medicine

<table>
<thead>
<tr>
<th>Core Modules 15 credits</th>
<th>Optional Modules 15 credits</th>
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<tbody>
<tr>
<td>• An introduction to genomics</td>
<td>• Advanced bioinformatics</td>
</tr>
<tr>
<td>• Omics techniques and their application to medicine</td>
<td>• Ethical legal and social (ELSI)</td>
</tr>
<tr>
<td>• Genomics of common and rare disease</td>
<td>• Counselling skills for genomics</td>
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<tr>
<td>• Molecular pathology of cancer</td>
<td>• Economic models and genomics</td>
</tr>
<tr>
<td>• Pharmacogenetics and stratified healthcare</td>
<td>• Professional and research skills</td>
</tr>
<tr>
<td>• Application of genomics to infectious disease</td>
<td>• Epigenetics</td>
</tr>
<tr>
<td>• Bioinformatics and interpretation</td>
<td>• Work-based learning</td>
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<tr>
<td>• Research dissertation (60/30 credits)</td>
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Reaching out across the professions

• GEP has developed a model with specialist diabetes nurses, with a network model for sharing genomic potential, knowledge and implications within a specialist clinical group.

• Looking to develop and roll out this model with other specialist groups

• Techniques and interventions for Nurses/ AHPs /Public Health will require further development to ensure relevance & effectiveness – Need to establish and set out the patient pathway so can determine ‘touch points’ for genomic technologies and competence requirements
Tailored work for primary care

- Alongside multiprofessional work the GEP is specifically looking at the needs of more generalist groups such as primary care.
- GEP has recruited a GP Adviser to lead on identifying the core genomic clinical activities and competencies required by primary care practitioners.
- This will inform the development of the education and training resources specifically required to support this role across the specific professional groups (eg GPs, Physician Associates, Nurses).
Education & Training GeCIP

Key indicative functions (aims)

- Oversight and coordination of HEE commissioned courses (including MSc programme)
- Embedding learning from 100K Genomes Project into mainstream education, training and workforce programmes
- Inform development of future cutting edge education and training
- Promote innovation in education and training and demonstrate its impact through pedagogic research

Stakeholders and roles

<table>
<thead>
<tr>
<th>GMC EnT leads</th>
<th>GeCIP EnT leads</th>
<th>HEI representatives</th>
<th>Int’l expert networks</th>
<th>Industry internships</th>
<th>Programme alumni</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexibility to train in current posts</td>
<td>Peer review and project supervision</td>
<td>Current experience and ability to feedback</td>
<td>Network to establish int’l programme of excellence</td>
<td>Internship and immersion in industry</td>
<td>Advocacy of genomic med programme</td>
</tr>
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Faculty of genomic medicine

Foundation to build on

- Dynamic and collaborative environment of GeCIP
- Existing wealth of knowledge and experience within the education system
- Funding opportunities
Support staff in GMCs to deliver 100kGP
Increase workforce capacity and capability in genomic medicine and bioinformatics
Funding Research and Innovation projects
Legacy and transformation

One lead in each GMC
13 Local HEE leads
Support 100k GP + wider workforce development
Sustainability and transformation

Co-ordinating Group
Education & Training leads from all 39 GeCIP domains
Crucial to the Legacy
International network
Membership open to others via submission of online form (www.genomicsengland.co.uk/join-a-gecip-domain/)

Deliver the commissions for masters and CPPD
Collaborate to maximise the benefits to the NHS & exploit institutional expertise
Partnership with the NHS/GMCs to support research and excellence in genomic medicine

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Faculty in Genomics Medicine

- All professionals who complete GEP training will be brought together to form a Faculty of Genomic Medicine
- This will serve two key purposes:
  - forming a community of practice to build and maintain genomic knowledge
  - act as champions within the wider workforce to drive forward the mainstreaming of genomic technologies across the NHS
## Resource development and evaluation plans for the 100,000 Genomes Project

<table>
<thead>
<tr>
<th>Resource</th>
<th>Mode of delivery</th>
<th>Assessment method</th>
<th>Evaluation outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eligibility wheels</td>
<td>Fact sheets (just-in-time)</td>
<td>None</td>
<td>Impact on practice (quantitative)</td>
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<td></td>
<td><em>GEP website</em></td>
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<tr>
<td>The consent conversation</td>
<td>E-learning (education)</td>
<td>Knowledge based (Formative)</td>
<td>Knowledge Impact on practice (mixed methods)</td>
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<td>Asynchronous learning</td>
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<td><em>GEP website</em></td>
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<tr>
<td>Tumour assessment tool</td>
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<td><em>GEP website</em></td>
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<tr>
<td>Sample preparation &amp; DNA extraction</td>
<td>Video (training)</td>
<td>Reflection exercise</td>
<td>Knowledge and skills Impact on practice (mixed methods)</td>
</tr>
<tr>
<td></td>
<td><em>GEP website</em></td>
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<tr>
<td>What is WGS</td>
<td>MOOC (education)</td>
<td>Knowledge based (Formative) and Reflection exercise</td>
<td>Knowledge (mixed methods)</td>
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<td>Synchronous learning</td>
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<td><em>FutureLearn platform</em></td>
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Evaluation plans for the Masters in Genomic Medicine

To ensure content is ‘fit-for-purpose’

1. Student feedback via usual HEI channels
2. Educator feedback through formal meetings with the GEP
3. This information will Inform review of curricula (1st review date Autumn 2016)
4. Implement any recommended (and appropriate) changes
   e.g. inclusion of ‘clinical education’ module as an optional module

To measure the impact of the Faculty of Genomic Medicine

Longitudinal study (using mixed methodology) to explore the:

1. Consolidation of the Faculty into a strong and effective community of practice
2. Role the Faculty have played in:
   – Awareness raising
   – Educational activities
   – Acting as a champion for their professional group
3. Impact of the Faculty on changing practice within the NHS
Reflections on GEP progress

• **Importance of networks** in driving change - interpersonal contact and influence is key to penetration of knowledge through the workforce

• Central role of GEP in **fostering collaboration** between network members (providers or professionals) – pushing against the natural desire for autonomy

• Collaboration will have a crucial **international dimension**. England can’t and won’t deliver the best by working in isolation

• **Measuring/Assessing competence** – GEP training programmes are tools to help people achieve competence. Many are formative learning experience, rather than summative

• Key challenge is **predicting the future** in a fast moving area of disruptive change. Need to be constantly identifying gaps & analyzing possibilities.

• Education has to evolve alongside technologies – so **evaluation must be an ongoing process**. eg Postgraduate scientist qualification in Genetics had to be reviewed in <5 years as change in science had been so great

• **Curricula need to be flexible, adaptable and empowering** giving staff the skills to respond as technologies and services change
Genomics Education Website
A single repository for GEP work

www.genomicseducation.hee.nhs.uk
Additional Slides
Health Education England - strategic role

HEE is one of the key national partners in the UK health and care system
It exists for one reason: to improve the quality of care delivered to patients. It ensures the workforce has the right skills, values and behaviours, in the right numbers, at the right time and in the right place.

Key areas of HEE Activity

Workforce planning and commissioning
Attracting & recruiting
Developing the existing workforce
Hospitals, primary & community care
Research, learning and innovation

While the NHS is a more structured and integrated system than elsewhere in the world, the success of HEE’s approaches is not through areas of direct control but through being recognised as an authoritative body that major stakeholders (eg Medical Royal Colleges) recognise and are influenced by.