

Genomics Education Programme NHS Health Education England

## Transforming the histopathology workforce: perspectives from the Genomics Education Programme

**Dr Anneke Seller, Scientific Director, HEE Genomics Education Programme**

Developing people for health and healthcare [www.hee.nhs.uk](http://www.hee.nhs.uk)

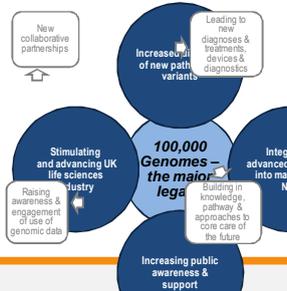


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## 100,000 Genomes: Cornerstone of future model for transformation

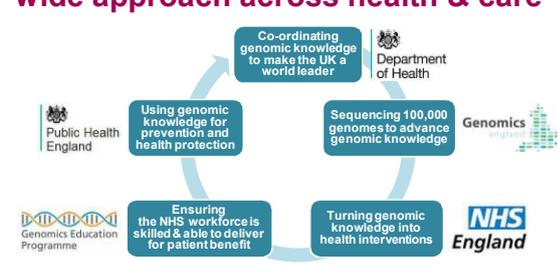
Key principles underpin the Project and the NHS contribution:

- 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&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



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## Genomics: a co-ordinated system-wide approach across health & care



Co-ordinating genomic knowledge to make the UK a world leader (Department of Health)

Using genomic knowledge for prevention and health protection (Public Health England)

Sequencing 100,000 genomes to advance genomic knowledge (Genomics)

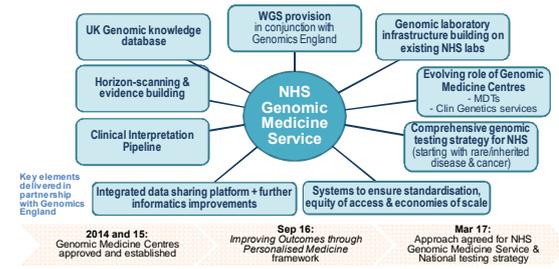
Ensuring the NHS workforce is skilled & able to deliver for patient benefit (Genomics Education Programme)

Turning genomic knowledge into health interventions (NHS England)

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## A framework for genomics in the NHS

Model bringing together the following elements to build on existing infrastructure



Key elements delivered in partnership with Genomics England:

- 2014 and 15: Genomic Medicine Centres approved and established
- Sep 16: Improving Outcomes through Personalised Medicine framework
- Mar 17: Approach agreed for NHS Genomic Medicine Service & National testing strategy

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## HEE Genomics Education Programme

- Established in 2014 with £20m Department of Health funding until March 2018. Programme to be embedded in HEE post 2018.
- Aims of the GEP:
  - Support 100,000 Genomes Project (Genomics)
  - Increase capacity and capability
  - Embed genomic medicine into mainstream practise
- GEP builds on the earlier work of the National Genetics Education and Development Centre

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## Strategy and approach

- Key aims:
  - Comprehensive reach across 1.3m NHS staff
  - Impact across whole education continuum for prospective and current workforce, across all professions
  - Remit ranging from awareness raising to highly specialised
- Gap analysis to ensure we are not duplicating efforts; and initiating joined-up activity between specialist groups and/or establishing networks so we are not working in isolation.
- Using up-to-date approaches rooted in educational theory and practice. evidence-based approach. And evaluating our impact.




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## Incorporating relevant genomic medicine at all stages of the education continuum

The GEP continuum of genomic medicine education

**Genomics knowledge into action**

**\*Pre-registration**  
**Core genomics concepts**  
 Real clinical examples to introduce major concepts; explain relevance to patient care

**Post-registration**  
**Contextualising the genomics concepts**  
 Expand appropriate underlying concepts, tailored for speciality/role

**Workplace**  
**Genomics in clinical practice**  
 Competences appropriate to role undertaken; as required information

*\*This also covers the training undertaken by non-registered NHS staff e.g. Nursing Associates*

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## Reaching out across the professions

Professions included: GPs, Midwives, Nurses, Genomic Counsellors, Doctors, Allied Health Professionals, Healthcare Scientists.

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## How is the GEP delivering?

- Devising curricula & establishing formal academic-based training routes
- Developing education & training resources (inc online & self-directed learning)
- Co-ordinating workforce planning (inc development of new professions (Bionformatics & Genetic Counselling))
- Commissioning NHS-funded training places
- Multi-professional clinical research fellowships & doctoral posts
- Broader awareness-raising materials (esp primary care, non-clinical roles & wider society)

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## Educational resources

Multiple access points for learners:

- Short online courses** ~ e.g. Intro to Bioinformatics
- Training modules** ~ e.g. Tumour Assessment Tool
- 'Just in time' resources** ~ e.g. Eligibility Wheels
- Videos, animations & infographics** ~ e.g. Sample processing films
- Blog and social media** ~ e.g. Latest research updates

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## Resources to support 100,000GP

**100,000 Genomes Project pipeline:** Identify the participant → Consent process → Sample collection & DNA extraction → Sequence annotation, validation and interpretation → Reporting of findings

- Eligibility Wheels:** 55 at-a-glance guides across 15 medical specialties to help clinicians identify eligible participants to join the 100,000 Genomes Project. 1,200+ downloads to date.
- Consent & Ethics:** Short online course designed for clinicians seeking participant consent to join the 100,000 Genomes Project. 2,200+ course completions to date.
- Sample Processing and DNA Extraction:** Series of instructional videos produced for staff in molecular genetics and histopathology labs. 3,600+ views to date.
- Tumour Assessment Tool:** Education and training modules for healthcare scientists and histopathologists on accurately assessing tumour samples for genomic sequencing. (DUE AUTUMN 2017)
- Validation of Results:** Package of education designed for clinical scientists who are verifying the pathogenic variations being returned by the sequencing process. (DUE 2017/18)
- Feedback of Results:** Package of education aimed at clinicians who interpret the genomic results report, and identify elements that will inform the patient's prognosis and treatment. (DUE 2017/18)

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## Sample Processing for Whole Genome Sequencing

- Series of instructional videos
- Includes reflective exercise
- 3,600+ video views to date

- Introduction
- Receiving samples for whole genome sequencing
- Extracting DNA from blood
- Preparing emicgsamples
- Processing solid tumour samples
- Extracting DNA from FFPE
- Summary

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## Tumour Assessment: Developing an innovative digital tool to test competence

- Specimen requirements for whole genome sequencing from tumour are very specific
- UK NEQAS data suggests estimation of cellularity and neoplastic content could be improved
- Collaboration with Prof David Gonzalez de Castro and Prof Manuel Salto-Tellez (RM/QUB)

**Please provide the % of tumour nuclei across the whole slide:**

0-10%	51-60%
11-20%	61-70%
21-30%	71-80%
31-40%	81-90%
41-50%	91-100%

**Please provide the cellularity content across the whole slide:**

- Very low (<700 cells)
- Low (<4,000 cells)
- Medium (4,000-10,000 cells)
- High (>10,000 cells)
- Very high (>50,000 cells)

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## Tumour Assessment in the Genomic Era

Developing people for health and healthcare **THE NHS CONSTRUCTION**

www.hee.nhs.uk

[\(Video web link\)](#)

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## How is the GEP delivering?

- Series of four training modules for biomedical scientists and histopathology staff, comprising:
  - Module 1: **Introduction to tissue pathology and pattern recognition for cancer**
  - Module 2: **Tumour assessment for genomic sequencing: why a systematic model is needed**
  - Module 3: **How to assess tumour samples for genomic sequencing: a systematic model**
  - Module 4: **Assessment**

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## Key features of the tool

- Three short online modules (c30-40 minutes each) featuring:
  - Overview of tissue pathology and cancer morphology
  - Evidence for a systematic model of tumour assessment
  - The systematic model in practice
  - Video and 3D animation
  - Knowledge check quizzes
- Virtual competence assessment module where learners will:
  - Estimate cellularity across the slide
  - Estimate % tumour across the slide
- All with single sign-in on the PathXL platform to emulate real-life laboratory assessment processes

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## MOOC on Whole Genome Sequencing

- Developed for healthcare professionals with limited understanding of the sequencing process
- Aim to raise awareness and understanding of genomic technologies
- First two runs (Sept 2016, Jan 2017):
  - >12,000 registered learners
  - 4,550 accessed course (>1,500 UK healthcare staff)
  - 114,128 steps completed
  - 7,201 comments posted

Whole Genome Sequencing: Decoding the Language of Life and Health

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## WGS MOOC learners

Sector	Examples	Motivation	
Healthcare	Specialists	Geneticists, Scientists, Genetic Counsellors	<ul style="list-style-type: none"> <li>Refresh their knowledge</li> <li>Hear from patients and wider clinical workforce</li> </ul>
	Wider clinical staff	Medical, Nursing, Healthcare Scientists, AHP, Public Health	<ul style="list-style-type: none"> <li>Know relevant for future role</li> <li>Personal interest</li> </ul>
	Non-clinical staff	Project Managers, Business Managers, Directors	<ul style="list-style-type: none"> <li>To understand more about their clinical colleagues/work</li> </ul>
Academia	Academics/ Researchers	Bench researchers, lecturers, teachers	<ul style="list-style-type: none"> <li>To understand more about their clinical colleagues/work</li> </ul>
Industry	Students	A-level through to PhD	<ul style="list-style-type: none"> <li>Improve knowledge and understanding</li> </ul>
	Scientific staff	Researchers	<ul style="list-style-type: none"> <li>Refresh knowledge</li> <li>New to the area</li> </ul>
Public	Non-scientific staff	Business Managers	<ul style="list-style-type: none"> <li>To understand the science</li> </ul>
	Professional role	Lawyer, Author etc.	<ul style="list-style-type: none"> <li>Professional and personal interest</li> </ul>
Patient	Lay people		<ul style="list-style-type: none"> <li>Personal interest</li> </ul>
	Personal history		<ul style="list-style-type: none"> <li>Undergoing WGS</li> </ul>
	Family history	Including parents	<ul style="list-style-type: none"> <li>What to know more about technology</li> </ul>

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## WGC MOOC learning experience

**Strong representation from health professionals**  
 I am a jobbing histopathologist working in the NHS in England. I am looking to keep up-to-date in a field that promises to have a tremendous impact on how I do my job in the near future.+

**Strong patient voice** provided a narrative throughout the course

- ~ Came for own motivation (learn more)
- ~ Provided a different viewpoint for the other learners

Social learning platform that **invites** and **enables** social learning, and involves facilitation to:

- . Answer questions
- . Encourage learners
- . Clarify misconceptions

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## WGS MOOC: Histopathology feedback

"My motive in taking this course is to have an expanded understanding of what happens with samples that I routinely handle and what is the eventual results we are hoping to achieve. ... These courses are a fantastic way of continuing my professional development."

"As I have not studied any genetics for over 10 years I would like to improve my knowledge of genetics and the technologies such as WGS which have emerged in the past decade."

"This course has given me a much clearer insight into what the process is, why it is done and why it is beneficial to patients to take part."

"I am looking to keep up-to-date in a field that promises to have a tremendous impact on how I do my job in the near future."

"I'm an academic clinical fellow in histopathology and wanted to learn a bit more about the changing role of genomics in molecular pathology."

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## Genomics Medicine Master's framework

**93% of MSc places filled**

- MSc 579 funded places
- PGDip
- PGCert
- CPPD 900 funded places

"The Master's will help prepare NHS staff for the future of genomics in contemporary healthcare"

"I am pleased the course is pitched at a high level as this provides a personal challenge+"

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## Master's framework modules

Core Modules	Optional Modules
Introduction to human genetics and genomics	Ethical, Legal and social issues in applied genomics
Omics techniques and their application to genomic medicine	Counselling skills for genomics
Genomics of common and rare diseases	Economic models and human genomics
Molecular Pathology of cancer and application in diagnosis	Professional and research skills
Pharmacogenomics and stratified healthcare	Advanced bioinformatics
Application of genomics in infectious diseases	Genome-based therapeutics
Bioinformatics, interpretation and data quality assurance in genomic analysis	Cardiovascular genetics and genomics
Research project / dissertation	Applied next generation sequencing
	Teaching, learning and assessment in healthcare science

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## Master's students by profession

Biomedical scientists\* (10%)  
 Histopathologists (6%)

\* Largest professional group, followed by:  
 Clinical geneticists (9%)  
 Genetic technologist (9%)  
 Nurse: research or clinical specialist (8%)

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## Genomics 101 Series

~ Series of 8 short online modules aimed at health professionals with limited or no genomics knowledge.

~ Designed to take the learner from genes and proteins, right through to how genomics can be used in clinical practice.

~ Will feature video, animation and infographics.

1. From gene to genome
2. Making a protein
3. Inheriting genetic information
4. Taking and drawing a family history
5. Classification of genetic conditions and variation
6. How genomics is used in healthcare
7. Communicating genetic and genomic information
8. How we investigate the genome

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## Professions and curricula

### Clinical Scientists in Genomic Specialisms

Specialism	STP	HSST
Genomics	GEP: Reviewed curricula	GEP: Pump primed
Genomic Counselling	GEP: Developed curricula and pump primed	In discussions
Molecular Pathology	In development	GEP: Pump primed
Clinical Bioinformatics	(Established 2013)	GEP: Developed curricula and pump primed

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## Professions and curricula

### Biomedical scientists

- GEP has met with the IBMS to discuss the development of molecular pathology modules at specialist and advanced levels

### Royal College of Pathologists

- Discussion regarding FRCPATH qualifications for the Genomic specialisms ( Genomics; Mol Path; Genomic Counselling and Bioinformatics)

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## Sustainability through the Faculty of Genomic Medicine

To serve as the **centre of knowledge and expertise** about how advances in thinking in genomic medicine will impact routine diagnosis, care and management of NHS and 3rd sector patients.

To act as a professional network that **drives the spread** of this knowledge and its implementation in practice across the services of the NHS and wide health system partners.

To inform, and be informed by, developments in genomics education and training, and research priorities in this space, **supporting innovation and change** in healthcare.

The role of faculty members is to act as **Genomics Champions**, sharing the communications from the Faculty Advisory Group, **influencing locally** with regards to genomic medicine and, as appropriate, play a role in Faculty

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## 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 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
- Curricula need to be flexible, adaptable and empowering** giving staff the skills to respond as technologies and services change
- 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**.

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## Genomics Education Programme online

[www.genomicseducation.hee.nhs.uk](http://www.genomicseducation.hee.nhs.uk) | 
 [www.twitter.com/genomicsedu](https://twitter.com/genomicsedu) | 
 [www.facebook.com/genomicsedu](https://www.facebook.com/genomicsedu)

Contact us @ [genomicseducation@hee.nhs.uk](mailto:genomicseducation@hee.nhs.uk)

@Genomicsedu #genomes100k www.genomicseducation.hee.nhs.uk

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## The GEP team

Sue Hill CSO	Nikki Latham SRO	Annela Seller Scientific Director	Max Foster Programme Director	Alison Pope Operations Manager
Michelle Bishop Education Development Lead	Jonathan Bowles Web & Multimedia Manager	David Callaghan Project Manager	Aine Kelly Commissioning Editor	Jacqui McDonald-Davis Project Manager
Annela McPherson Assistant Editor	Edward Miller Education Development	Charlotte Murray Engagement Officer	Siobhan Simpson Education Development	Charlotte Szczepanik Project Administrator

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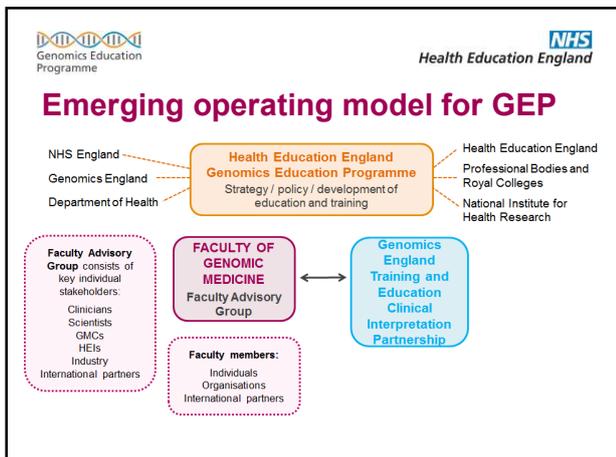
### Master's students by qualification

**Total number of students by course type**

Course Type	Total Number of Students
CPD	~180
MSc	~450
PG Cert	~120
PG Dip	~30
<b>Total</b>	<b>~780</b>

**Total number of Histopathologists and Biomedical Scientists by course type**

Course Type	Biomedical Scientist	Histopathologist
CPD	~10	~5
MSc	~60	~25
PG Cert	~5	~5
PG Dip	~2	~2



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### Cancer and rare disease: Key areas for a genomic approach

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    graph LR
      A[All cancer is a genetic disease - understanding precise drivers informs treatment approach] --> B[Genomics will play a major role in informing surgical, radiotherapy and oncological strategies]
      B --> C[Transformation in genomic pathways will improve outcomes and see more patients eligible for trials - building new links to industry/research]
      D[High incidence of rare disease (3.5 million) - diagnosis poor at present] --> E[Established approaches involve repeated visits and diagnostic odyssey - genomics reduces service demand]
      E --> F[WGS offers greater diagnostic yield & precision - supporting earlier intervention]
  
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