Sharing Resources:
Panel discussion on moving from research into clinical care

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Chair: Kathryn North
Speakers: Sue Hill, Peter Goodhand, Anna Middleton, Clara Gaff, Heidi Rehm, Zornitza Stark

The world is changing

Global Alliance for Genomics & Health

Percentage of whole genomes and exomes that are funded by **healthcare** systems

Areas of clinical uptake: infectious disease, cancer, rare disease, common/chronic

How big is healthcare - worldwide

Global Alliance for Genomics & Health

MRI – ($400-$4,000) 100 million scans - pa

PET/SPECT ($1000-$6,000) 50 million scans - pa

Opportunities

Global Alliance for Genomics & Health

If we can enable secondary use of clinical genomic data for research we will have a >60 million virtual cohort by 2025.

Global genomic data sharing can lead to...

- Demonstrated patterns in health and disease
- Increased statistical significance of analyses
- Matching other / similar patients, leading to increased diagnoses
- ‘Stronger’ variant interpretations
- More informed clinical decisions

Global Alliance for Genomics & Health

150+ Genomic Data Initiatives Globally

CLINICAL/GENOMIC MEDICINE

40

initiatives

RESEARCH

70

initiatives

NATIONAL

21

from 15 countries

COHORTS

64

globally

HTA – Government decision making

Global Alliance for Genomics & Health

- Geisinger/Regeneron – fund exomes and evaluate in practice
- Kaiser Permanente – very diligent HTA pre introduction
- Canadian clinical genomes for RD diagnosis or large panels for cancer
  - Several provinces - re-patriate “out-of-country tests” optics vs budget control; secondary use for research versus rather than pdf report; build the competency and capacity in hospital labs versus cost, speed, clinical certification; over capacity in research sequencing but lab not certified for clinical use
  - Other provinces no experience with clinical NGS- only research experience; ministries of health need clear, well articulated case with HTA that they will regard as valid and the competency/capacity – Pop scale 8.5 m vs ~1m or <
  - Work force, wait list, diagnostic odyssey, early identification, role of AI

Five times the diagnosis, one quarter the cost

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A prospective evaluation of whole-exome sequencing as a first-tier molecular test in infants with suspected monogenic disorders

Zornitza Stark, MD[1], Tiong Y. Tan, MD, PhD[1,2], Belinda Chong, PhD[1], Gemma R. Brett, MSc, MGenCouns[1,3], Patrick Yap, MD[1], Maie Walsh, MD[1] Alison Yeung, MD[1], Heidi Peters, MD, PhD[1,2,4], Dylan Mordaunt, MD[1,2,4], Shannon Cowie, BSc[1], David J. Amor, MD, PhD[1,2], Ravi Savarirayan, MD[1,2], George McGillivray, MD[1], Lilian Downie, MD[1], Paul G. Ekert, MD, PhD[1,7], Christiane Theda, MD, PhD[1,3], Paul A. James, MD, PhD[6], Joy Yaplito-Lee, MD[1,4], Monique M. Ryan, MD[1,2,4], Richard J. Leventer, MD, PhD[1,2,4], Emma Creed, MGenCouns[1,3,6], Ivan Macciocca, BSc, MHSc[1], Katrina M. Bell, PhD[1], Alicia Oshlack, PhD[1,7], Simon Sadedin, BSc, BEng[1], Peter Georgeson, BEng, BMath[7], Charlotte Anderson, BSc, MRes[1], Natalie Thorne, PhD[1,2,5]; Melbourne Genomics Health Alliance, Clara Gaff, PhD[2,5], Susan M White, MD[1,2]

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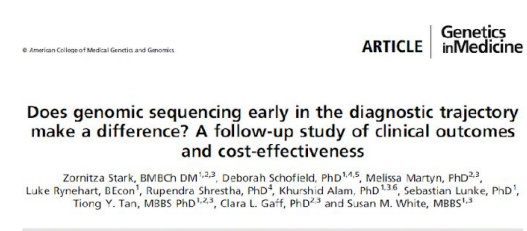
Prospective comparison of the cost-effectiveness of clinical whole-exome sequencing with that of usual care overwhelmingly supports early use and reimbursement

Zornitza Stark, MD[1], Deborah Schofield, PhD[1,2,3], Khurshid Alam, PhD[1,4], William Wilson, PhD[5,6], Nessie Mupfeki, MHIM[1,5], Ivan Macciocca, MHSc[1,5], Rupendra Shrestha, PhD[2], Susan M. White, MD[1,4,5] and Clara Gaff, PhD[4,5]



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Does genomic sequencing early in the diagnostic trajectory make a difference? A follow-up study of clinical outcomes and cost-effectiveness

Zornitza Stark, BMBCh DM[1,2,3], Deborah Schofield, PhD[1,4,5], Melissa Martyn, PhD[2,3], Luke Rynehart, BEcon[1], Rupendra Shrestha, PhD[4], Khurshid Alam, PhD[1,3,6], Sebastian Lunke, PhD[1], Tiong Y. Tan, MBBS PhD[1,2,3], Clara L. Gaff, PhD[2,3] and Susan M. White, MBBS[1,3]

Prospective comparison of diagnosis

- 80 children <2 years of age
- Features of known mendelian conditions
- 58% diagnosis vs 11% in standard care

Cost effectiveness study of first 40 children

- Cost per diagnosis $5047 vs $27050 std care
- Incremental saving of $2,181 per additional dx
- Bootstrapped & sensitivity analysis

Follow up cost utility study

- Cost saving of AU$1,578 per QALY gained
- No increase in hospital service use.

Design *Gaff et al, (2017) npj Genomic Medicine 2: Article 16*

Evaluation for effective education

Genetic specialists: Current practice and workforce

Other medical specialists: needs, practice, preference

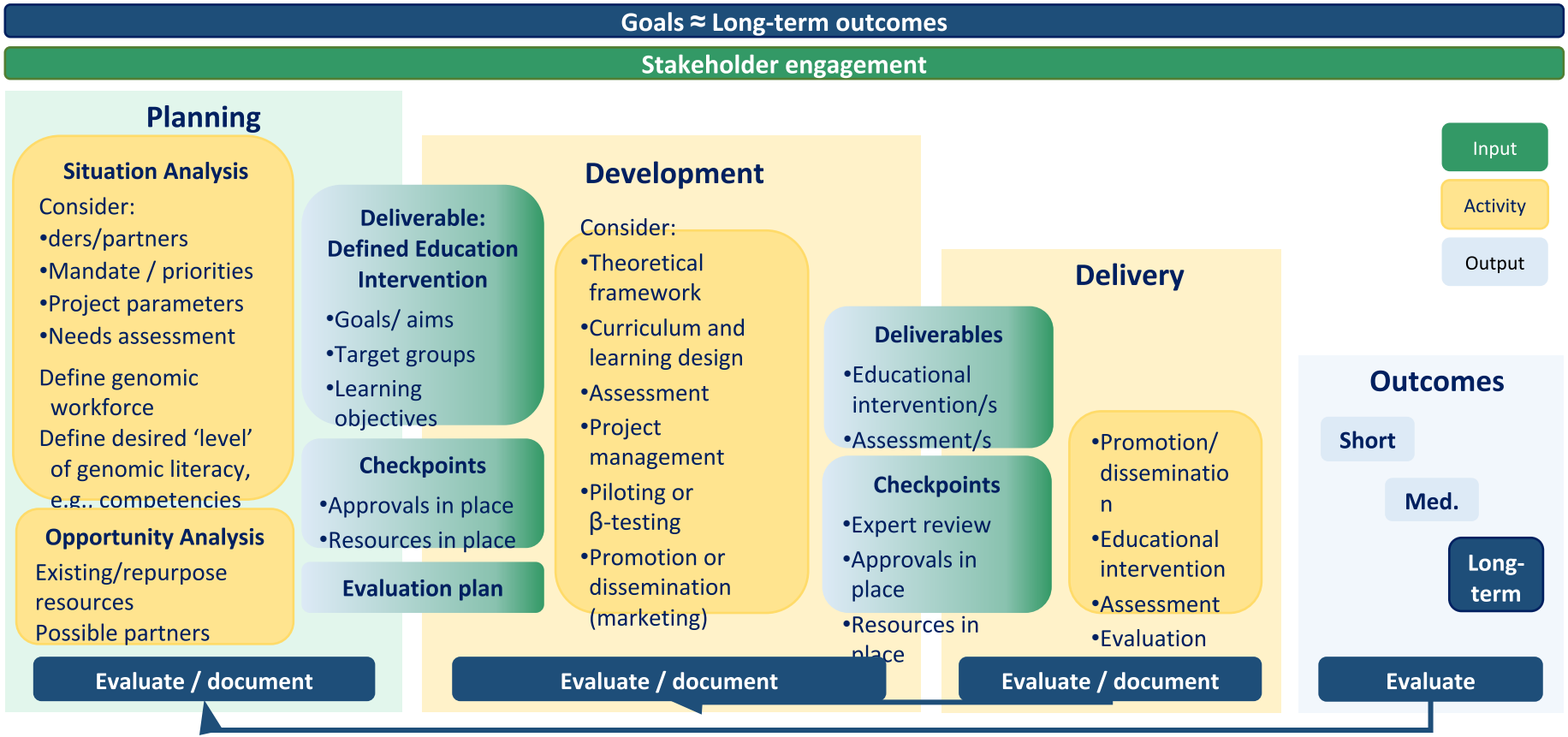
Tools to assist genomic education design and evaluation

frontiers in Genetics

Research Topic

Educating Health Professionals in Genomic Medicine: Evidence-Based Strategies and Approaches

Program logic + evaluation framework for genomic education



100,000 Genomes Project:
structured to build the approach for future care

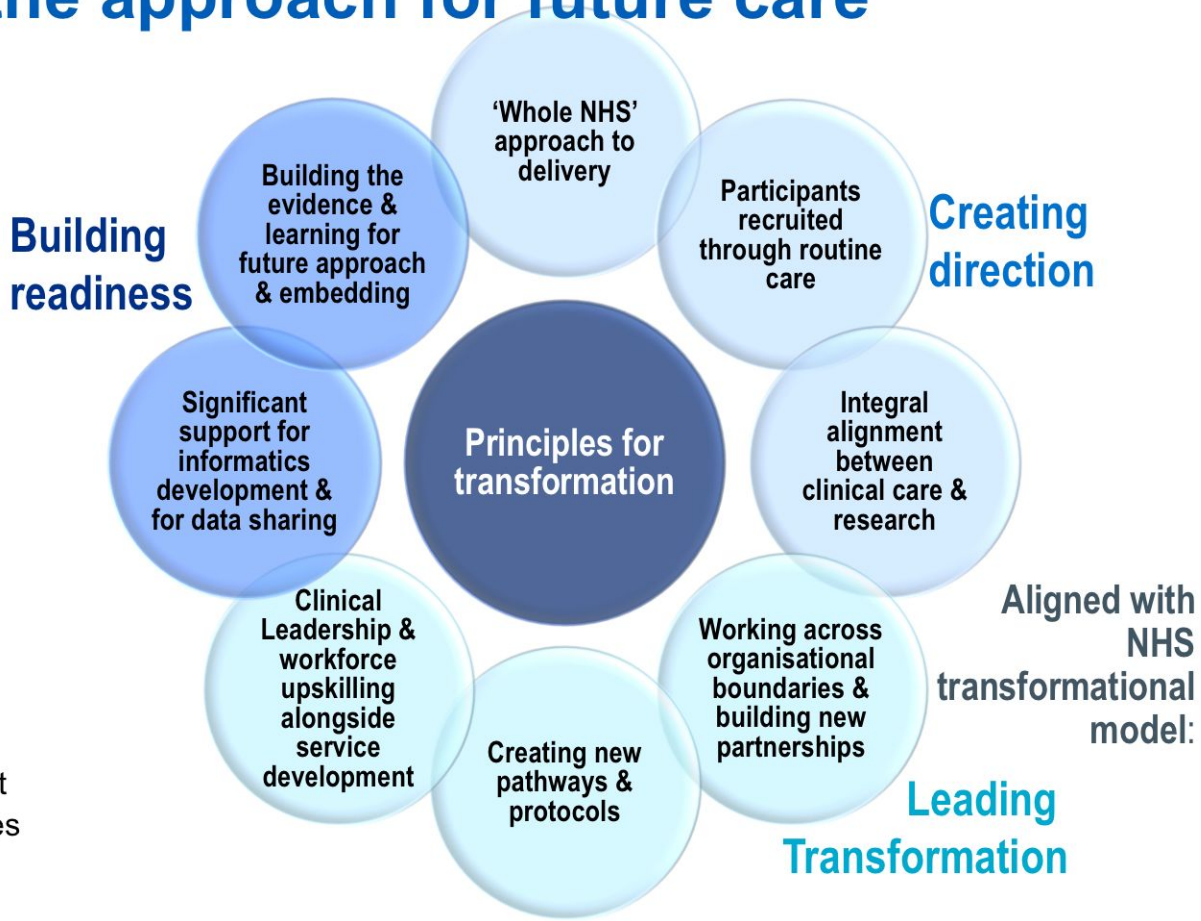
Proof of concept through the 100,000 Genomes Project

4 principles

1. WGS extends current diagnostic scope
2. Recruitment from routine care, treated through routine channels
3. Participants consent to sharing of de-identified data for R&D & industry use & longitudinal access
4. Establishes model for transformational change

4 key legacies

1. Increased discovery of new pathogenic variants
2. Integrating advanced genomics into mainstream NHS
3. Increasing public understanding & support
4. Stimulating and advancing UK life sciences industry



Policy & Strategy Alignment

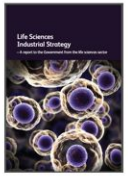
Five Year Forward View 2014

Improving outcomes through Personalised Medicine 2016
(PM framework)

100,000 Genomes Project 2013

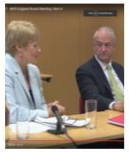
CMO: Generation Genome 2016
(societal engagement)

Building on our Inheritance 2012
(lab reconfiguration)



Life Sciences Industry Strategy 2017

National Genomic Healthcare Strategy
to come 2019



NHS England Board: Genomic Medicine Service 2017
(approval for service)

CMO: Better Health Within Reach 2018
(data-led healthcare)

NHS Interim Workforce Plan 2019
(implementing LTP inc genomics req'mts)

NHS Long Term Plan 2019
(500k WGS; improved cancer offer; CVD)

NHS

Governance

Ministerial: **National Genomics Board**

NHS & GeL: **Partnership Board**

NHS England: **SRO – Genomics Programme Board**

NHS England: **Service Partnership Boards (GMC/GLH)**

Making the case for genomics

COST/BENEFIT

- Understanding cost of multiple sequential testing/ unwarranted variation & establishing activity
- Replacement of outmoded technologies – enhanced diagnostic yield above SoC
- Made clinical & economic case for both non-WGS & 500K WGS in mainstream care & mechanism for annual review & prioritisation
- Gained tripling of investment in genomics over next 5 years & centralisation of budgets

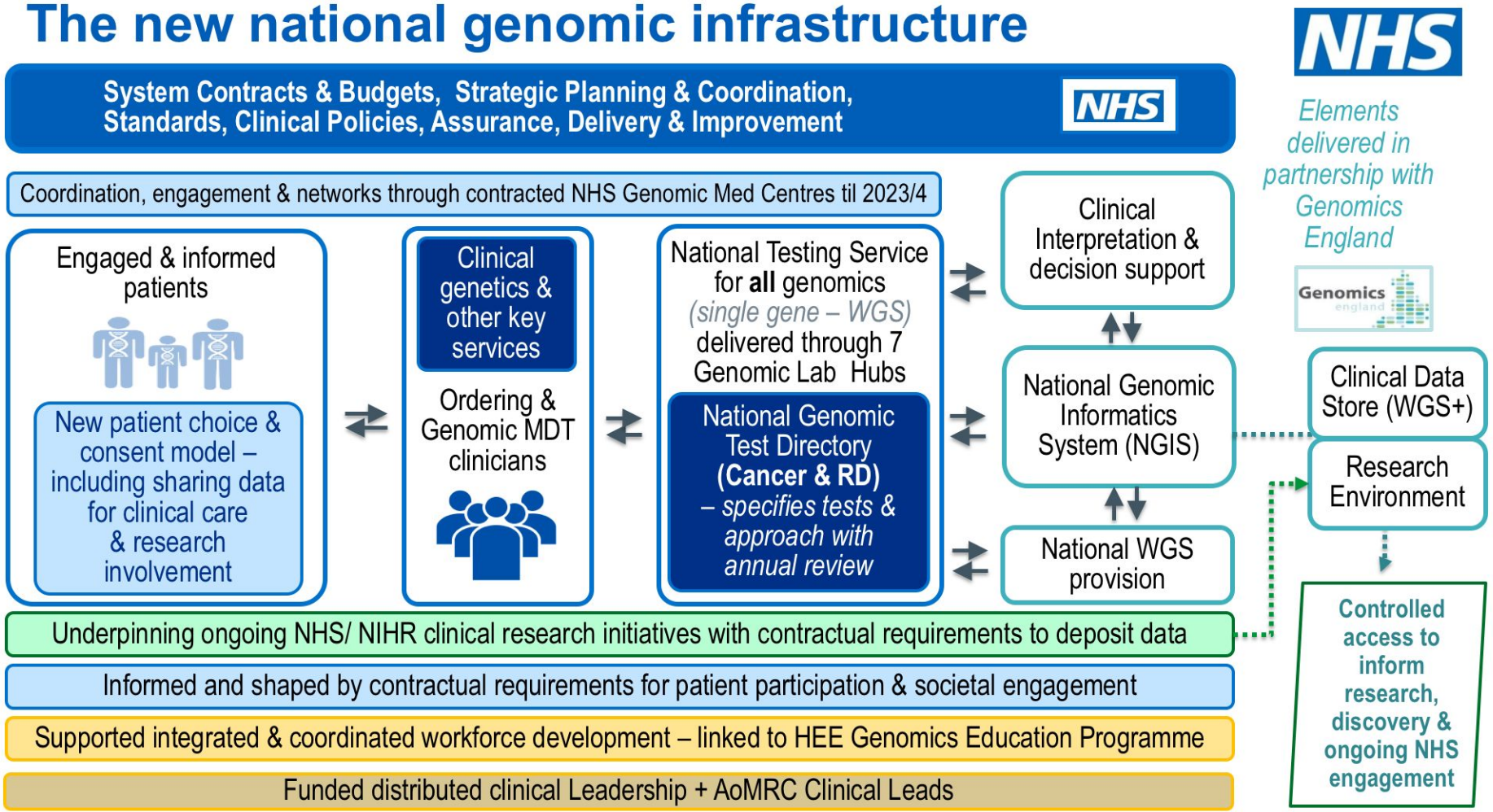
QUALITY & OUTCOMES

- Improving care in key national clinical priority areas (Cancer/ Rare Disease/CVD/Acute Care)
- Supporting and linking with personalisation/ medicines optimisation & ADR reduction *(NHS drugs budget £17bn pa)*
- Established principle & buy in for single national approach, protocols, standards, datasets, data sharing, IG, metrics & scrutiny (quality dashboard) *inc National Genomics Testing Service & National Genomics Test Directory*

DELIVERY & SERVICE MODEL

- Established WGS deliverability and requirements for whole infrastructure (inc non-WGS) with NHS informatics and data developments
- Service & human cost of diagnostic odyssey
- Reducing inequity and unmet clinical need
- Demonstrated value of new models of care and how existing services could be consolidated & networked

The new national genomic infrastructure



Developing the health system workforce alongside service transformation

The Genomics Education Programme was established in 2014 to run alongside the developments in genomic medicine services to driving training and upskilling for the **entire 1.3 million NHS** workforce

The GEP provides a wide range of free-to-access resources to provide an **'*anytime, anyplace, anywhere*'** approach to education – tailored to suit the range of professional requirements, the extent and time available for learning & the immediate need for education

Central to the programme is the multiprofessional **Masters in Genomic Medicine** (& associated CPD modules) and specialist commissioned training places (eg Bioinformatics & genomic counselling) + undergraduate & postgraduate training curricula

Resources and material at *genomicseducation.hee.nhs.uk* and *www.futurelearn.com*

Resources show huge reach

50,000+ total staff reached

1400+ Masters framework places

1.5million+ web page views

460,000+ resource views

34,440 course registrations

19,600+ MOOC registrations

HEE GEP Cumulative data 2015-2018:

Public Engagement

Prof Anna Middleton
Wellcome Genome Campus, Cambridge, UK
www.wgc.org.uk/ethics

Public engagement is **not** education

It is:

Making a connection, Building a bridge

No scientific jargon, but culturally acceptable metaphors

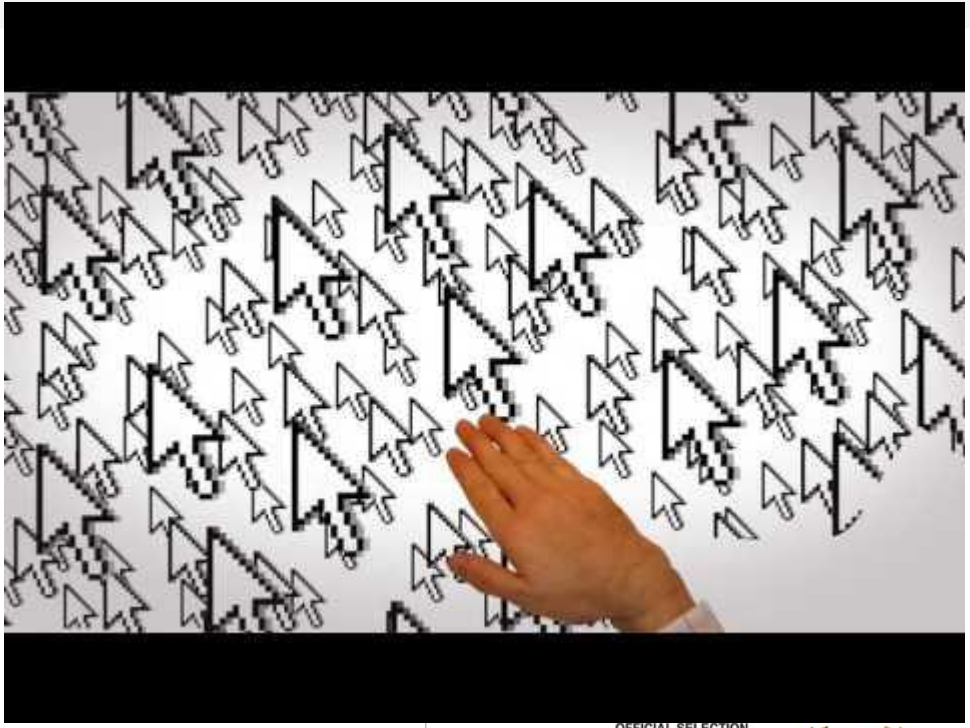
Different engagement for publics and patients

We already have 50+ GA4GH films on genomic data sharing, translated into 14 languages, plus 20 other films in English (incidental findings, genetic counselling terms etc)

Light touch, google search as a metaphor for sequencing

Prof Anna Middleton
Wellcome Genome Campus, Cambridge, UK
www.wgc.org.uk/ethics

(Click on image to open video in YouTube)



Deeper connection, dominant inheritance, used within clinic

Prof Anna Middleton
Wellcome Genome Campus, Cambridge, UK
www.wgc.org.uk/ethics

(Click on image to open video in YouTube)