Genomics Interoperability Workshop

Agenda	
Introduction (14:00-14:20) *Provide an overview of the current landscape of Genomics since the inception of the 100K project and the future of Genomics in healthcare.*	**Debbie Porter** – Deputy Director, Transformation, Genomics Unit, NHS England.
Genomics Background (14:20-14:50) *Provide the background on Genomics, benefits and current challenges*	**Rachel Mein** – Senior Laboratory Advisor, Lab and Scientific Team, Genomics Unit, NHS England. **John Fraser** – Head of Informatics, Genomics Unit, NHS England; Data and Informatics Director, North East and Yorkshire NHS GLH
Coffee Break (14:50-15:00)	
The Genomic Interoperability Challenge (15:00-15:20) *Provide an overview of the current challenges within Genomics faced by clinicians.*	**Adam Laurent** - Business Analyst, Genomics Unit, NHS England. **Harini Nallapothola** - Business Analyst, Genomics Unit, NHS England.
Coffee Break (15:20-15:50)	
The Genomic Future Vision for Interoperability (15:50-16:50) *Provide an overview of the current activity undertaken by NHSE, discussion of minimum datasets, requirements, messaging profiles and I/A options. The goal of the session is to understand the current capabilities of suppliers to move clinicians from paper based to electronic test ordering and result receipt within the Genomics space.*	**Ravi Natarajan** - Technical Architect, Genomics Unit, NHS England **Adam Laurent** - Business Analyst, Genomics Unit, NHS England **Harini Nallapothola** - Business Analyst, Genomics Unit, NHS England.
Closing Remarks and AOB (16:50-17:00)	

Current strategic direction for genomics

NHS England

Genomics strategy

A number of key documents already outlining strategic approach to genomics in the UK. Although The NHS Long Term Plan includes some genomics commitments, there is still a need to **clearly set out the strategic direction of travel for genomics in the NHS**

Sets out the importance of genomics

UK Life Sciences Vision sets 10-year strategy for sector to solve some of the biggest healthcare problems of our generation

Key themes include: to support the NHS to test, purchase and **spread innovative technologies** and to **build on UK science and clinical research** infrastructure and harness the unique genomic and health data.

Sets out key areas of focus across the UK

Genome UK; the future of healthcare sets out a 10 year vision how we will achieve progress in genomic medicine across three pillars:

- **Diagnosis & Personalised medicine**
- **Prevention**
- **Research**

Genome UK: shared commitments for UK-wide implementation 2022 to 2025 published March 2022 sets out a series of shared commitments for UK-wide implementation including: over the next 3 years review and advise on how pharmacogenomics technology can reduce harmful prescribing

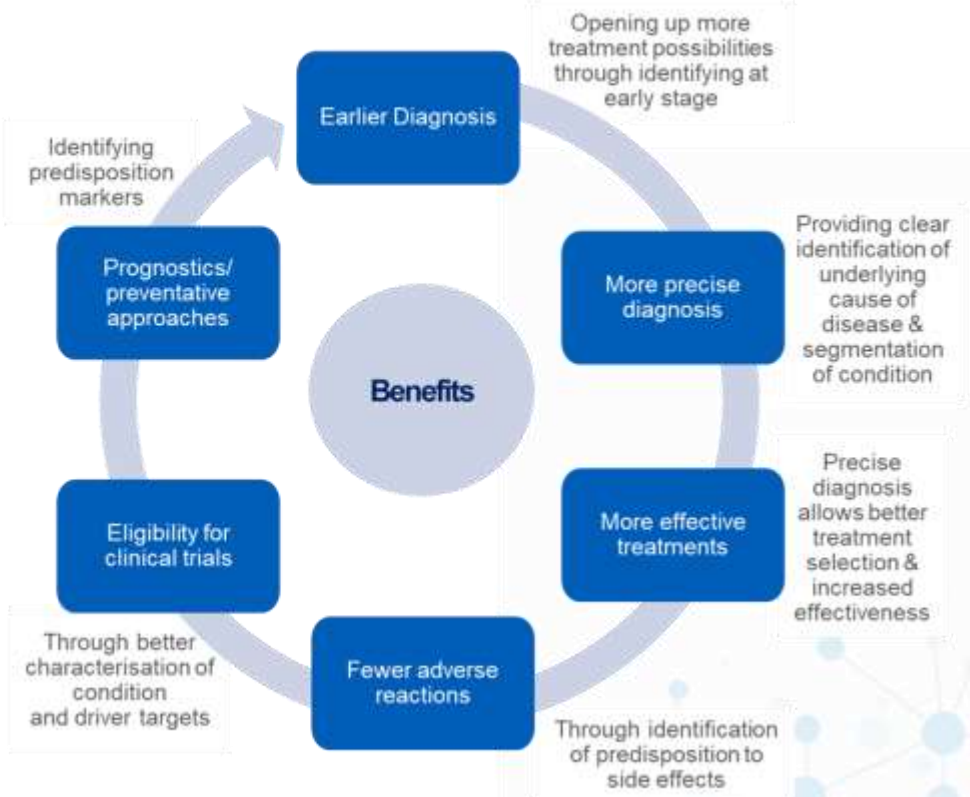
Broader NHS direction of travel with some specific genomics commitments

NHS LTP genomics commitments:

- Sequence 500,000 whole genomes by 2023/24
  - All children with cancer
  - Seriously ill children likely to have a genetic disorder
- Extended access to molecular diagnostics to be routinely offered to all people with cancer
- Expanding access to genomic testing for Familial Hypercholesterolaemia
- Linking and correlating genomic clinical data and patient data
- Improve recruitment to clinical trails and support research
- Data driven improvements to care and informed decision making

Outcomes ⟷ **Comparison** ⟷ **Discovery**

Genomics driving a new paradigm in care



Requires:

- Change in clinical practice
- Workforce development
- Empowered patients and public

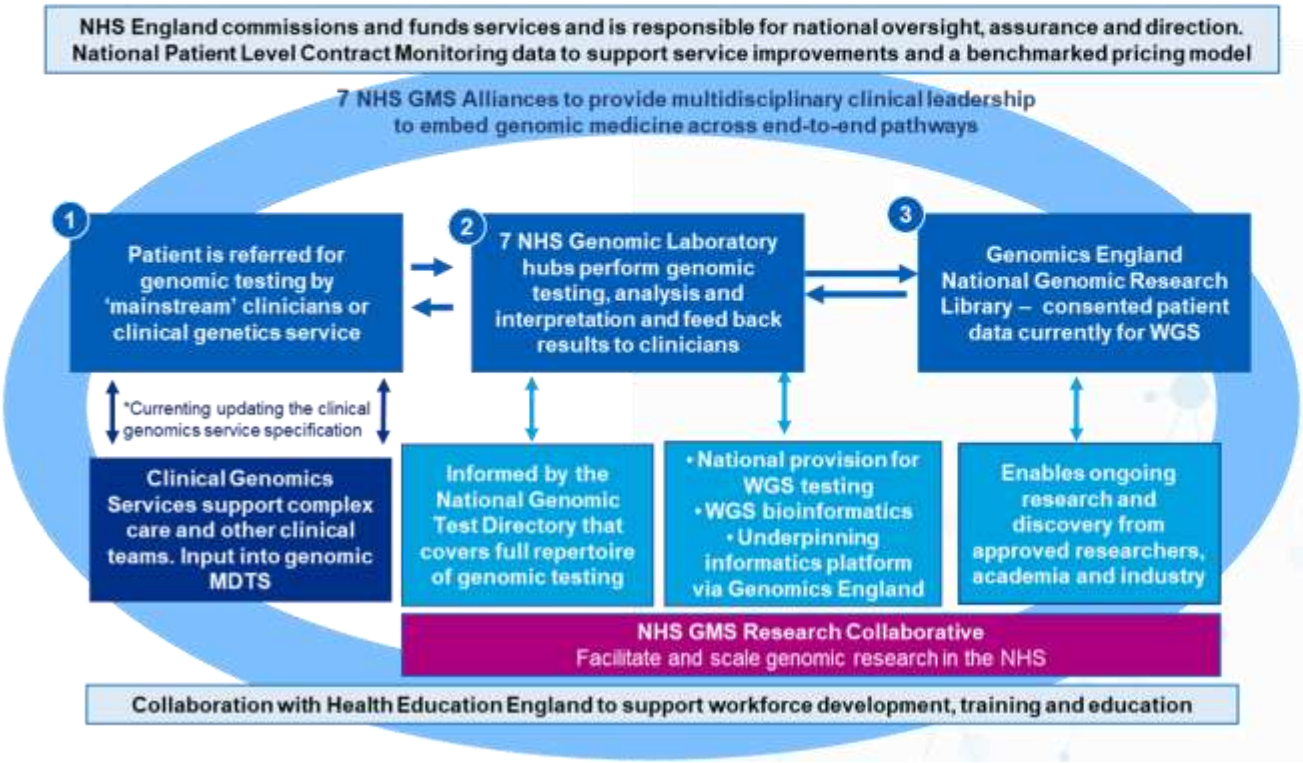
NHS Genomic Medicine Service – implementation at scale

The NHS Genomic Medicine Service from 2018

Building on the existing NHS infrastructure and lessons from the 100,000 Genomes Project

NHS England

Overarching aim: To enable the NHS to harness the power of genomic technology and scientific advances to improve population health and patient outcomes, building upon the commitments and approach to genomic medicine in the NHS outlined in the NHS Long Term Plan, the Genome UK Strategy and the Life Sciences Vision



Key principles:

- Be **clinically and scientifically led**
- Have **patients and public involved** at all levels
- Ensure **equity of access** for all patients
- Have a **standardised** model of delivery and commissioning across the country
- **Be responsive** to innovation and new technologies
- Routine care aligned with **Research and Development**
- Inform and drive change using **data led insights**
- Aligned with **personalised and precision medicine** agenda

Mainstreaming and embedding genomics

NHS England

7 NHS Genomic Medicine Service Alliances across the country, aligned to the geographies of the NHS GLHs, providing:

NHS System Level

Working with all partners across a geography; includes ICS, Cancer Alliances, regional NHSE/I teams and local clinical leadership and partnership with key partner boards. Governance links with the Genomic Laboratory Hubs.

Over 200 funded posts in NHS GMS Alliances to support multiprofessional leadership including medical, nursing and pharmacy

Clinical Leadership

Multiprofessional engagement and leadership at all levels

Genomic medicine focused 'Supra regional' clinical directorates

- Engage with clinical leaders, advocates, and champions across a geography
- Creation of clinical genomic senates and other advisory structures

Working with wider networks, Academy of Medical Royal Colleges and other professions

Transformation

Service models and projects to drive embedding of genomics:

- Local and National approach
- 7 key national transformation projects and multiple projects running in the regions

End to end pathways and linking to medicines optimisation

Workforce development

Working with Health Education England at national and regional levels for appointment of education and training leads by linking needs with priorities

Driving forward increases in supply linked to the understanding of demand, introducing skill mix and new ways of working

Cohesive approach | Forward looking | Right people, right place

Where genomics could take us in the future

NHS England

"We estimate that over 60 million patients will have their genome sequenced in a healthcare context by 2025"

Birney, E et al (2017). doi:10.1101/203554

Equitable access to cutting-edge comprehensive genomic testing with rapid adoption of new technologies and exploration of functional genomic pathway

E.g. rapid WGS, long read sequencing, ctDNA

Increase use of genomics in population health including understanding risk and enabling preventative treatment and interventions

E.g. polygenic risk scores and newborn sequencing

Genomics testing undertaken closer to the patient

E.g. point of care testing in NICU for gentamicin

Continued focus on precision medicine to end to 'one size fits all medicine' based on genomic and other clinical data what about integration with other diagnostics

New drug discovery models

Enhanced viral & pathogen sequencing

Aid future pandemic preparedness

Investment in digital and informatics infrastructure to support data sharing and national research endeavours and greater collaboration with industry

Equitable access to clinical trials

Future projects in partnership with Genomics England

NHS England

Cancer 2.0

Proof of concept work to explore the use of long-read sequencing technology in cancer and look at the integration of multiple data sources and new technologies in a multi-modal approach to cancer genomic testing

Diversity in genomic data

Enriching genomic dataset by sequencing cohorts from diverse backgrounds, engaging with relevant communities, and developing analytics to derive the most value possible from the data

Sequencing in newborns

Preparatory work and engagement on a research study to sequence genomes of newborns to diagnose and avoid harm from early-onset treatable disease. An NHS steering group led by Sarah-Jane Marsh, Chief Executive of Birmingham Women's and Children's Hospital has been set up to help gather and shape input to the proposals

Genomics – background, benefits and challenges

Rachael Mein

Senior Laboratory Adviser, Lab and Scientific Team,

Genomics Unit, NHS England

What is Genomics?

GENOME: Complete set of genetic material (DNA) in an organism

GENOMICS: Study of genomes (structure, function, evolution, cause of disease)

GENETICS: Study of heredity and variation of inherited characteristics

Human genome:

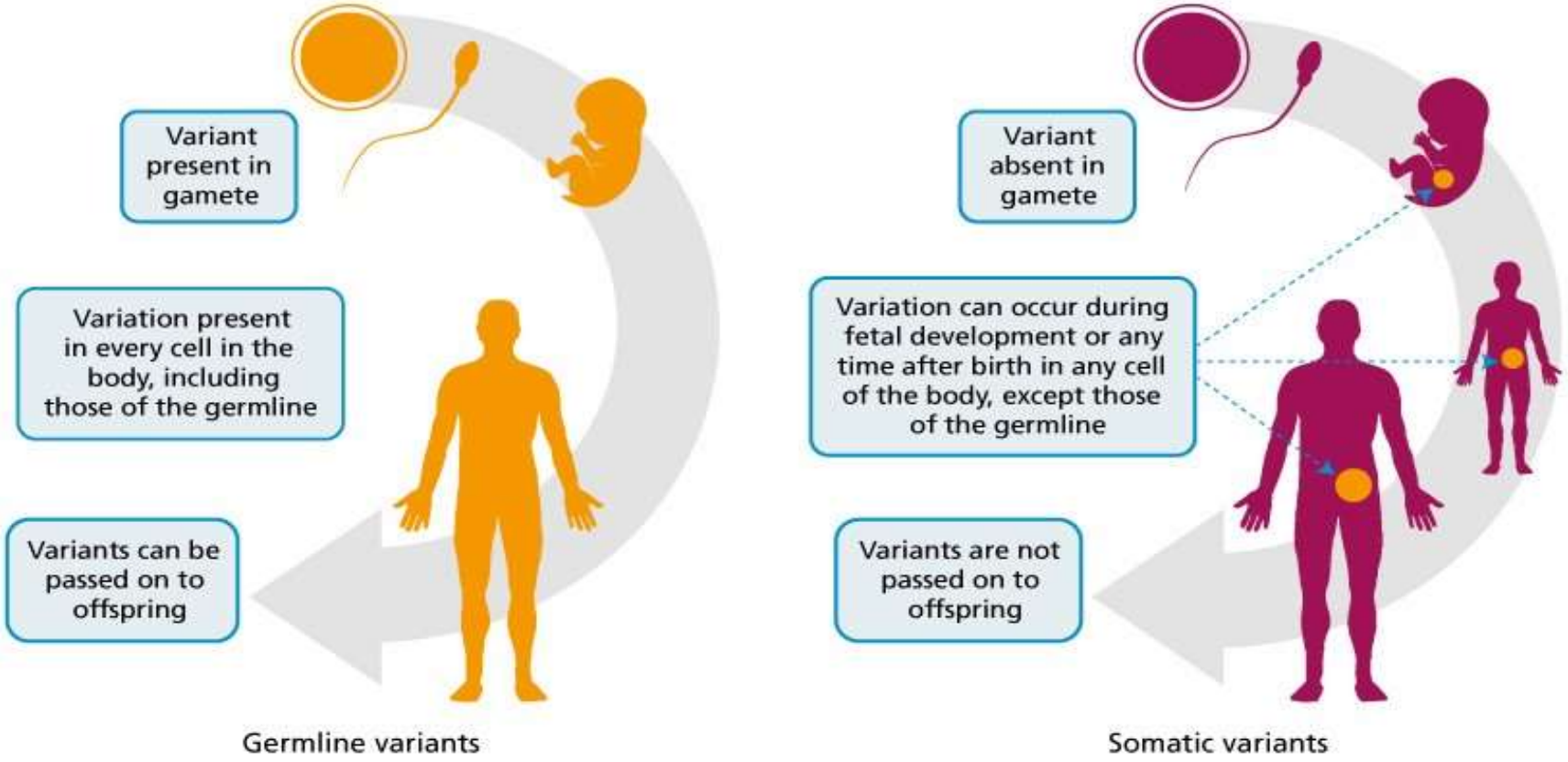
3 billion bases

20-25,000 protein coding genes

46 chromosomes

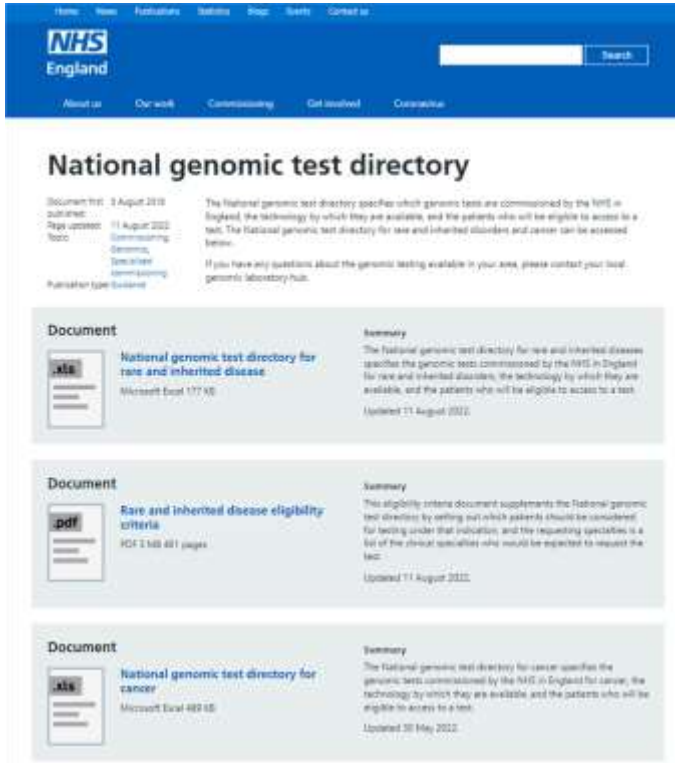
1-2% DNA codes for proteins

Rare & inherited disease vs Cancer (somatic)

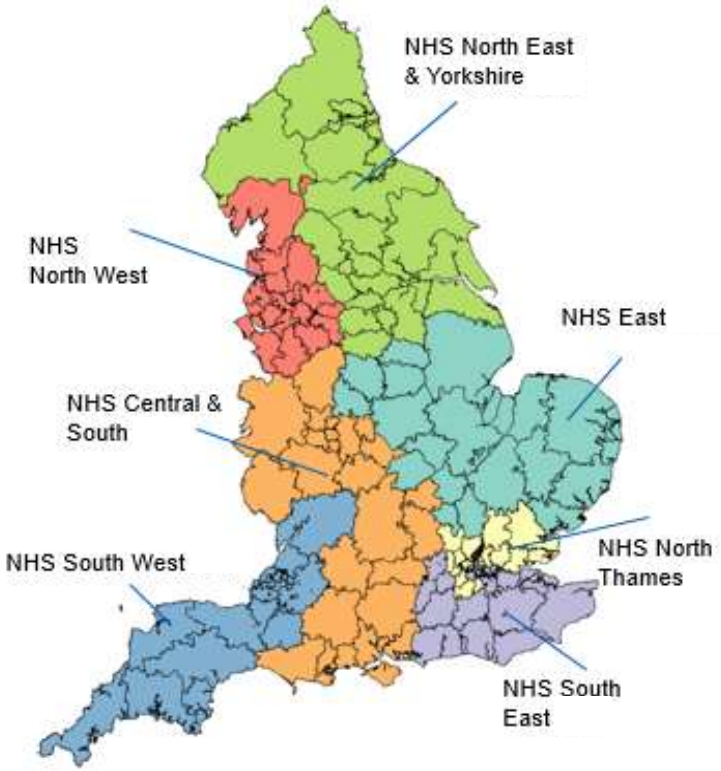


What is the Genomics Medicine Service?

- Centrally NHS commissioned service for patients within England
- National Genomic Test Directory lists the range of genomic tests available to all eligible patients
- Provides equity of access and standardisation
- Rationalisation and expansion of tests available
- 2 Parts of service;
  - Rare and Inherited Disease (germline)
  - Cancer (somatic)
- 7 Regional hubs
- Not all tests provided by all GLHs (Core & Specialist, <7)
- Patient samples to be tested in another GLH are sent via local GLH

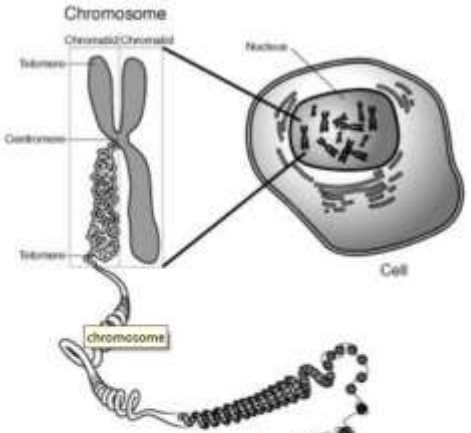


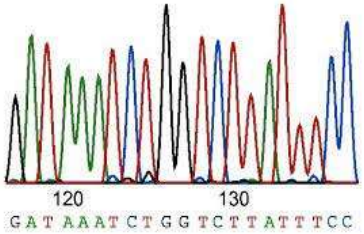
NHS GMS infrastructure across England

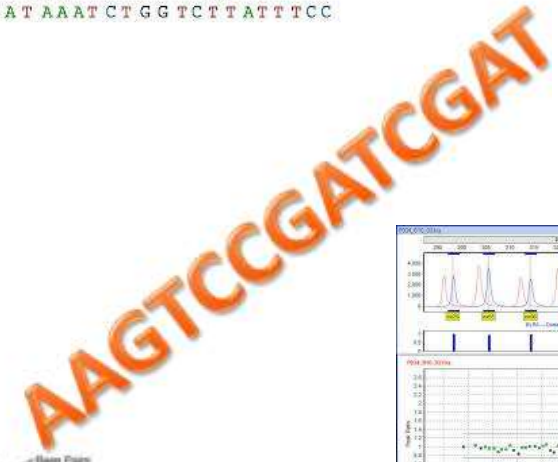


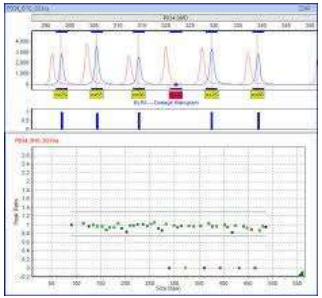
Geography	Population	GLH	NHS GMS Alliances	Clinical genomics services	NHS trusts in region
North East & Yorkshire	8 million	1 GLH 2 LGLs	4 GMS Alliance partners	3 clinical genomics services	33 NHS Trusts
North West	7 million	1 GLH 3 LGLs	9 GMS Alliance partners	2 clinical genomics services	33 NHS Trusts
Central & South	10 million	1 GLH 3 LGLs	4 GMS Alliance partners	3 clinical genomics services	43 NHS Trusts
East	8 million	1 GLH 2 LGLs	4 GMS Alliance partners	3 clinical genomics services	31 NHS Trusts
North Thames	7 million	1 GLH 3 LGLs	10 GMS Alliance partners	2 clinical genomics services	32 NHS Trusts
South East	8 million	1 GLH 3 LGLs	4 GMS Alliance partners	2 clinical genomics services	25 NHS Trusts
South West	4 million	1 GLH 1 LGL	3 GMS Alliance partners	2 clinical genomics services	17 NHS Trusts

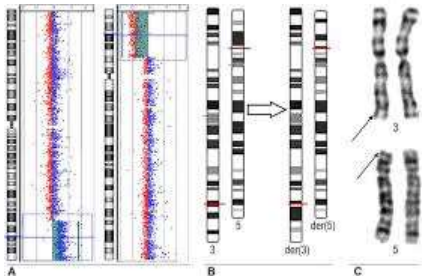
What testing do we do?

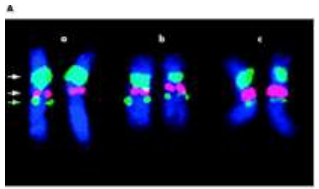












Flagship services

- Rapid testing for acutely unwell children. Analysis of >3000 genes
- Rapid testing for fetal anomalies. Analysis of ~1000 genes
- Many specialist services with expert genomic knowledge in cardiology, dermatology, endocrinology, gastro-hepatology, haematology, haring, immunology, inherited Cancer, metabolic, mitochondrial, muscular skeletal, ophthalmology, renal, respiratory…….

Who are our users?

- Genomic variation can result in any biological system not working properly
- Therefore deleterious changes in our DNA sequence can result in many abnormalities from brain development to an inability to metabolise certain foods, from muscle weakness to short stature.
- Therefore clinicians who refer patients for genomic testing can be from all specialities, hospitals, outpatient clinics etc

- Laboratories need; an appropriate sample to test, to know what test is required, clinical information to assess eligibility and interpret results
- When considering inherited disease linking family members is key so you know what to test for as most genetic variation is private to a single family

What benefits do genomics bring

- Targeted treatment
- Personalised medicine to improve efficacy or avoid side effects
- Predictive testing to inform screening and intervention
- Carrier testing to predict chance of a child affected with disease in family
- Prenatal diagnosis and reproductive choice
- Management of symptoms
- Prognosis
- treatment, therapies
- Having a diagnosis!

Making a difference for patients

NHS England

Thousands of cancer patients are benefitting from the introduction of **DPYD testing** which can prevent adverse drug reactions and **NTRK gene fusion testing** to support new histology independent cancer treatments

The **GRAIL partnership** is looking at early detection of cancer and is being piloted in 165,000 patients

The simple genetic test for newborns that can prevent profound deafness and save the NHS millions every year

BBC NEWS

Cancer: Blood test for 50 types to be trialled by NHS

NHS to pilot blood test that coul detect over 50 different cancer types

CANCER RESEARCH UK

Rollout of **Non-Invasive Pre-natal Diagnosis** for Retinoblastoma, one of more than 15 new tests and amendments to the National Genomic Test Directory.

Mail Online

Lee Morris underwent **Ocular Gene Therapy** at Manchester University NHS Foundation Trust in one of the first gene therapy treatments undertaken by the NHS.

BBC NEWS

Genetic tests to detect rare cancer in unborn babies rolled out

New genomics-based treatments for cancer – since April 2021

Trastuzumab deruxtecan (HER2)
hundreds of people given immediate access to drug which treats a type of breast cancer called HER2 positive breast cancer

April '21

Sotorasib (KRAS)
lung cancer drug that targets "death star" mutation and could see hundreds of patients benefit

March '22

April '21

PHESGO (HER2)
Thousands of patients set to benefit from '5-minute breast cancer treatment'

Dostarlimab
New life-extending drug for advanced endometrial cancer with deficient mismatch repair

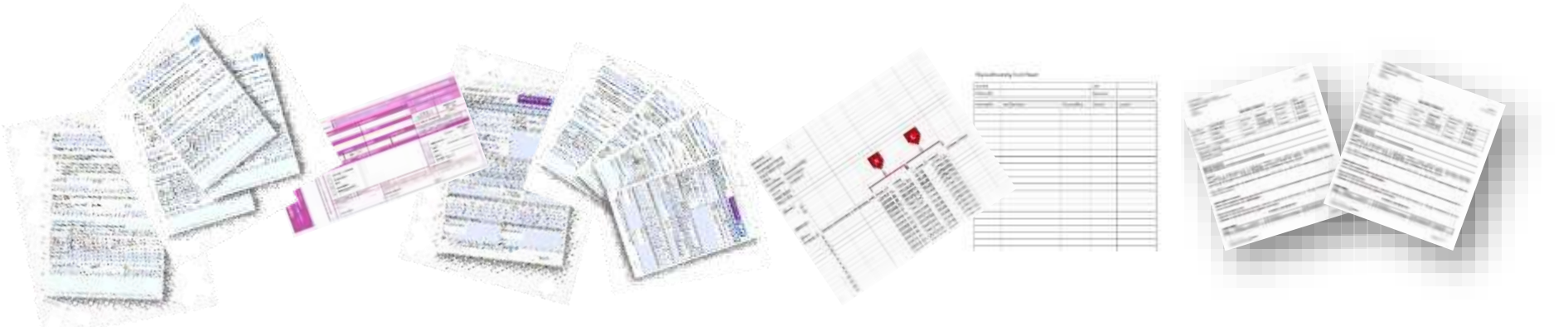
Feb '22

May '21

Osimertinib (EGFR)
Over 100 patients with a rare form of lung cancer gain early access to new drug that halves the risk of cancer returning

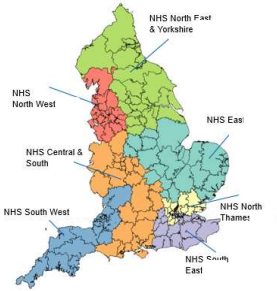
What is holding us back

- We’re good at the science!
- Don’t need a science degree for admin and manual data transfer/transcription of data from one system to another.
- Inefficient use of skilled workforce.
- Transcribing information is error prone
- Cannot track samples across end to end pathway



Example of interactions within and between GLHs

South East	8 million	1 GLH 3 LGLs	4 GMS Alliance partners	2 clinical genomics services	25 NHS Trusts



- Referrals/samples from numerous departments within each NHS Trust from community clinics to hospitals
- Paper form accompanies sample and is manually entered into LIMs
- Need to match to existing patient record and family members records
- Patient/sample identifier included in test worksheets, equipment, analytical equipment/software, results entry, reports…..Lots of copy & paste!
- Send samples and/or data to LGLs within GLH
- Send samples to other GLHs for specialist testing
- Send samples and reports to support testing of family members in other GLHs
- Sending reports out to clinicians
- Audit

Genomics – informatics challenges

John Fraser

Head of Informatics, Genomics Unit, NHS England

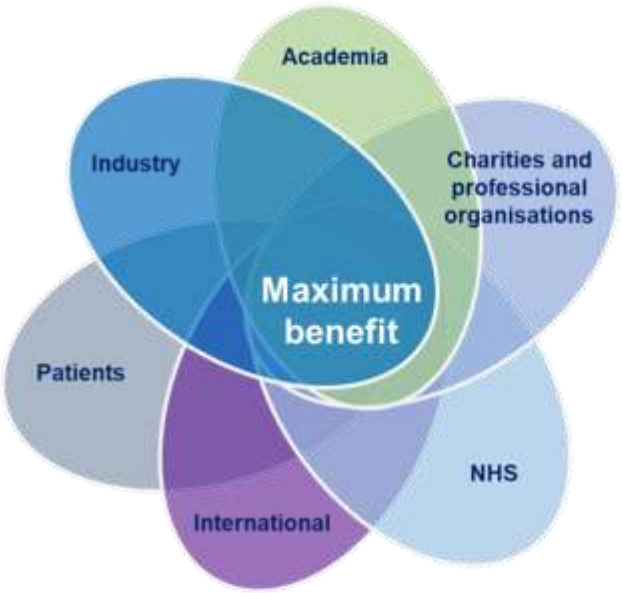
Data and Informatics Director, North East & Yorkshire NHS GLH

Whole system transformation in the NHS

NHS England

	Issue	Action
	**Variation in access**	National commissioning and finance mechanisms to ensure standardisation and service stability: • **Secured funding for infrastructure** • **National standards and specifications for delivery of services** • **Regular assurance monitoring**
	**Dispersed infrastructure**	Comprehensive clinical and organisational infrastructure to deliver consistent, high quality genomic medicine. Key components of infrastructure include: • **Consolidated laboratory infrastructure** • **Standardised clinical pathways** • **Embedded workforce, education and training**
	**Lack of performance data**	Performance monitoring to ensure service is being delivered in line with expected standards • **Benchmarking to understand trends between GLHs** • **Monitor access to testing and improve equitability** • **Inform future commissioning arrangements and understand where additional actions or support may be required**
	**Clinical leadership concentrated in clinical genetics**	A dedicated multidisciplinary clinical leadership across the system • **Drives and delivers leadership and partnership at all levels including a bottom-up approach to learning and embedding** • **Collaborative governance, system leadership and strategic partnership**
	**Embedding of innovation and new technologies**	• **Significant NHS investment in 100,000 Genomes Project** as proof of concept for whole genome sequencing as part of routine clinical service – set up of 13 NHS Genomic Medicine Centres, extensive clinical leadership and pathway transformation • Infrastructure to support rapid adoption of new technologies for example long read sequencing technology and liquid biopsy
	**Lack of IT connectivity**	Developed understanding of fundamental need for data sharing – while ensuring confidence in confidentiality and data security • **Created NHS informatics and data infrastructure for genomics** • **Brought multiple systems together to collate and curate clinical data for an individual** • **Developed a rich clinical dataset with standard nomenclature and data models (HPO, SNOMED CT)** • **Established national database of consented and deidentified genomic (WGS) and clinical data**

Building successful partnerships



The single biggest driver of genomic medicine success has been the ability to build and create partnerships – within & across organisations and across the globe and initiatives such as the Global Alliance for Genomics and Health and the Global Genomic Medicine Collaborative

Particular areas for genomic partnerships include:

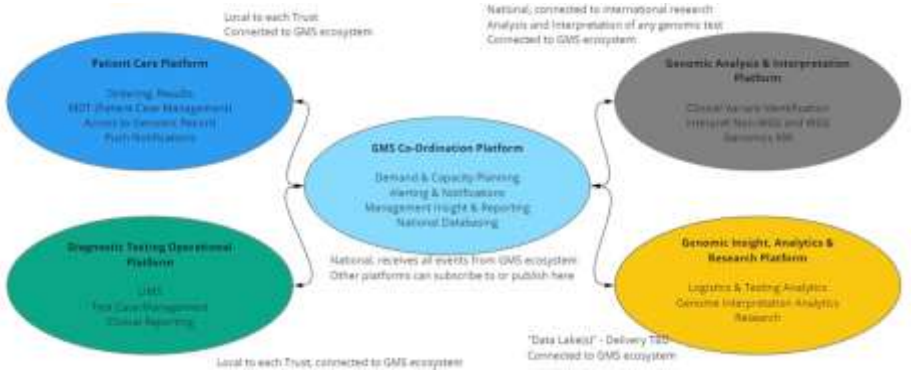
- Exchanging information, sharing data and best practice
- Establishing evidence synthesis against agreed policy domains
- Agreeing common standards and outcome metrics
- Enhancing interpretation of complex information and establishing global resources
- Communication and engagement

INVENTION → EVALUATION → ADOPTION → DIFFUSION

What are the immediate informatics challenges?

- Uplift of laboratory management systems
  - Resilience and portability across sites
- New bioinformatics processes and technologies
- Large volumes of sensitive data
  - Security, indexing and access
- Access to genomic diagnostics from multiple clinical systems
- Embedding genomics capabilities into mainstream clinical systems

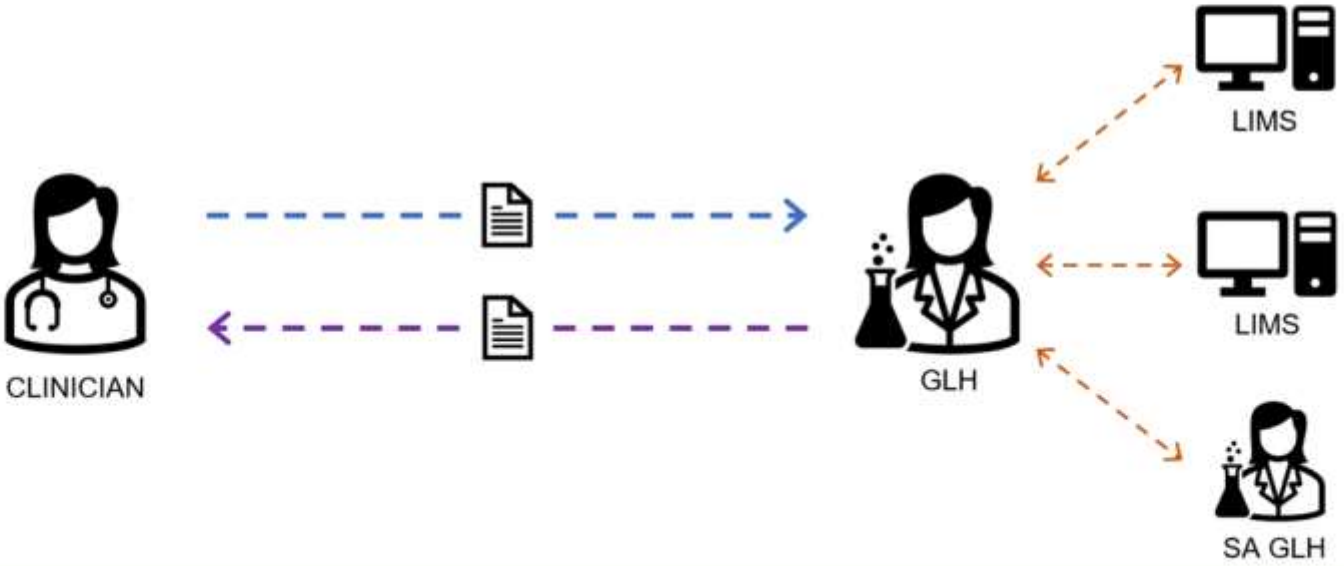
Agreeing standards for interoperability are essential for all of these.



INTEROPERABILITY OVERVIEW

Adam Laurent - NHSE Business Analyst
Harini Nallapothola - NHSE Business Analyst
Ravi Natarajan - NHSE Technical Architect
Omar Khan - NHSD Senior Technical Modeller

GENOMIC TEST ORDERING



PROBLEM STATEMENTS

What problems are we addressing?

MANUAL INTERVENTION

TRACKING

INFORMATION SHARING

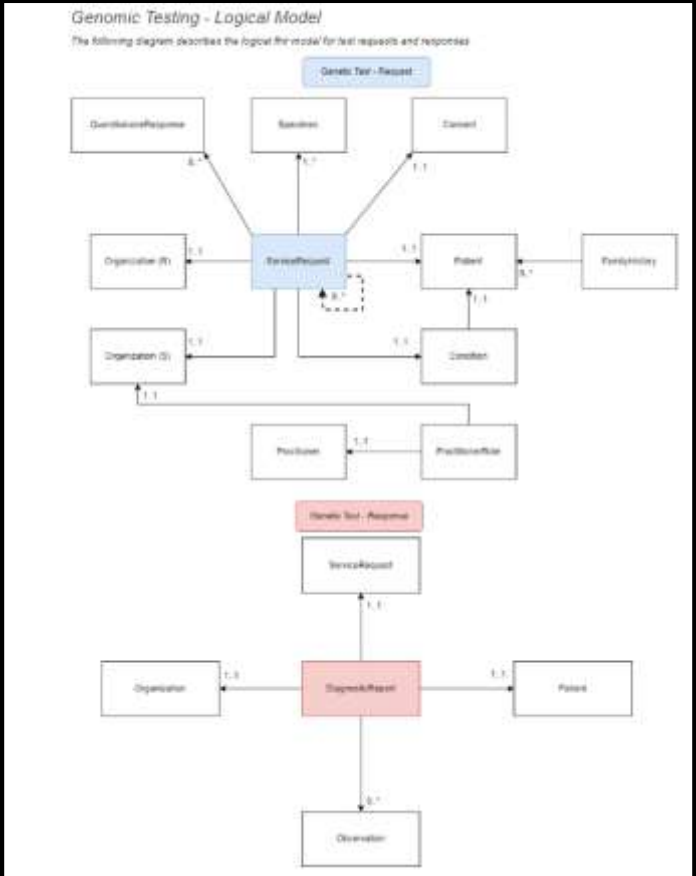
TEST DIRECTORY

INTEROPERABILITY PROGRAMME ACTIVITY


MINIMUM DATASET

OE	GLH	PLCM	GEL	Data elements		Non WGS Rare Disease	Non WGS Cancer	WGS Rare Disease
				Referring clinician				
X			X	Full name		Mandatory	Mandatory	Mandatory
X				Phone		Mandatory	Mandatory	Mandatory
X				Email address		Mandatory	Mandatory	Mandatory
X			X	Hospital name and address		Mandatory	Mandatory	Mandatory
				Index patient details				
X		X	X	Patient identifier (NHS number/Other)		Required	Required	Required
X			X	Patient reason for unavailable NHS number		Required	Required	Required
X			X	Patient first name		Mandatory	Mandatory	Mandatory
X			X	Patient last name		Mandatory	Mandatory	Mandatory
X		X	X	Patient date of birth		Mandatory	Mandatory	Mandatory


MESSAGING PROFILES



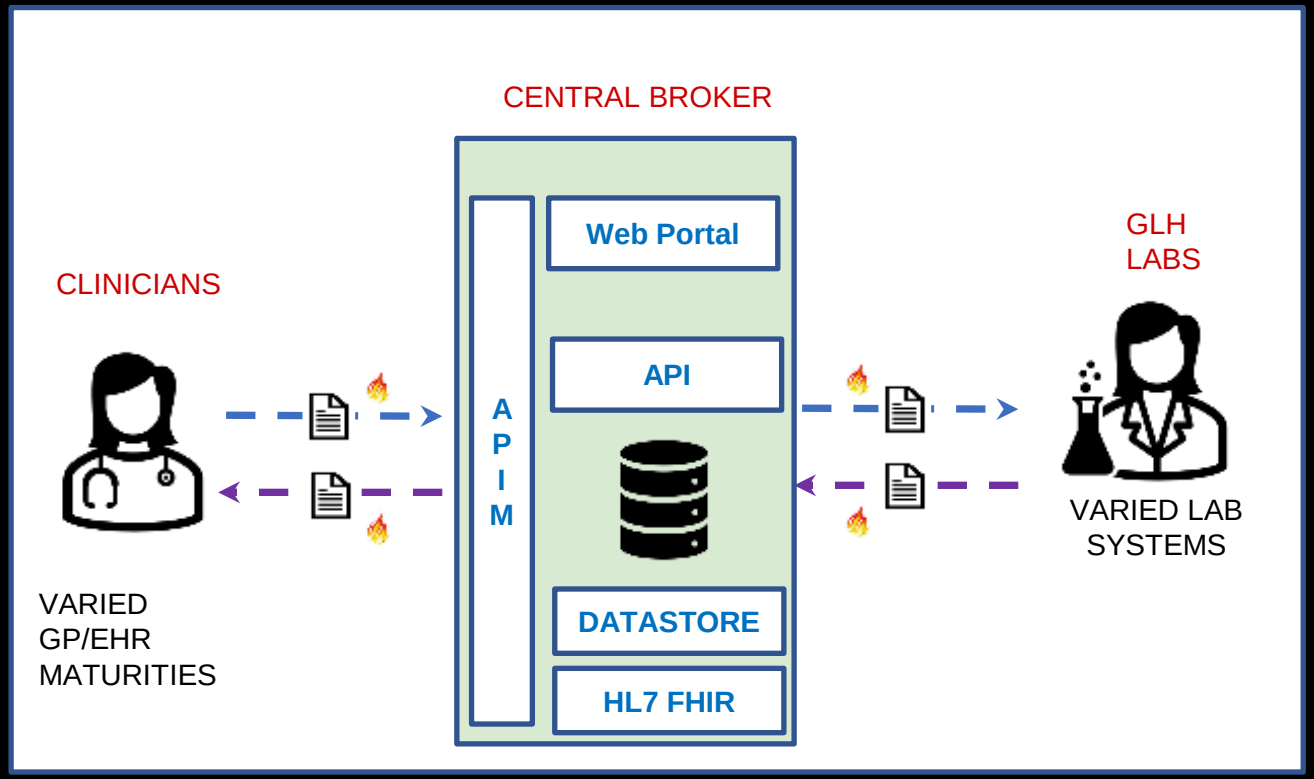
- HL7 FHIR Standard
  - Adoption of UK Core R4
  - Data mapping between minimum data set to FHIR elements
  - Reuse of existing communication patterns
    - Messaging
    - Task workflow
- Curated and Developed in SIMPLIFIER Forge
  - Early draft sample FHIR IG and draft resources available here
- Collaboration with pathology and imaging work streams on alignment of the work done.
- Active engagement with NHSD IOPS for the overall deliverables.
  - Structured reporting - HL7 International Genomics IG engagement


REQUIREMENTS GATHERING


ISN

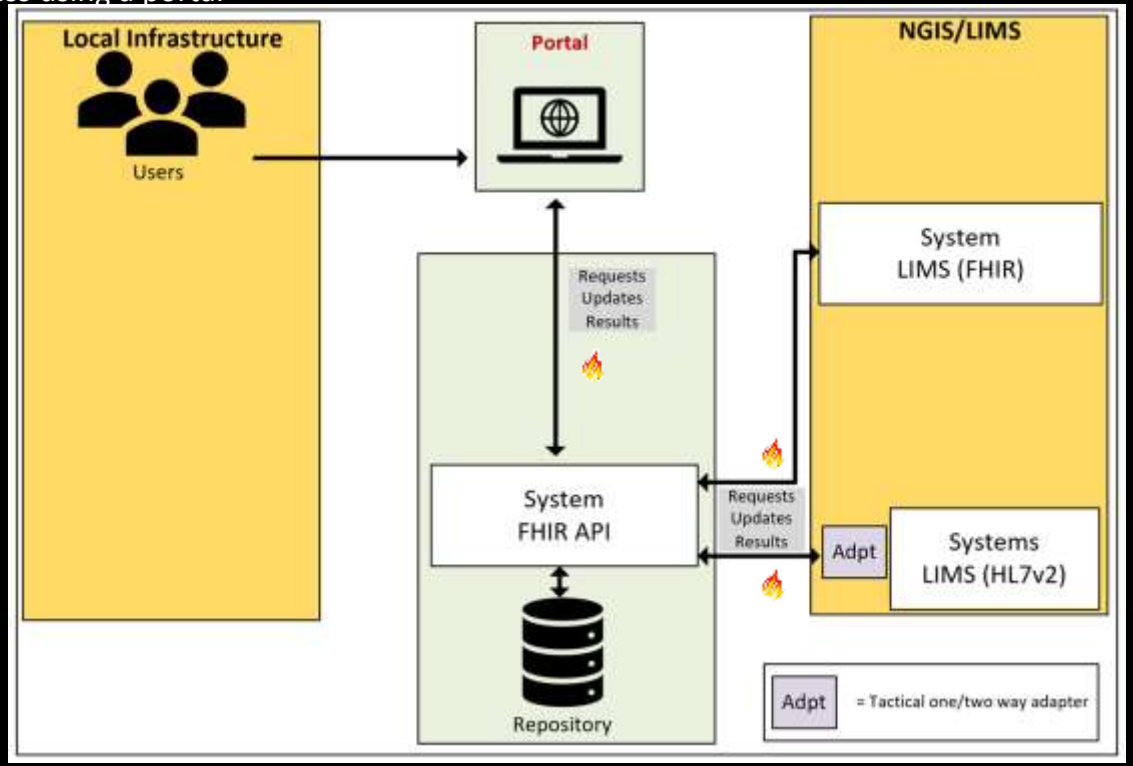

PROPOSED ARCHITECTURE

Genomic Test Ordering System



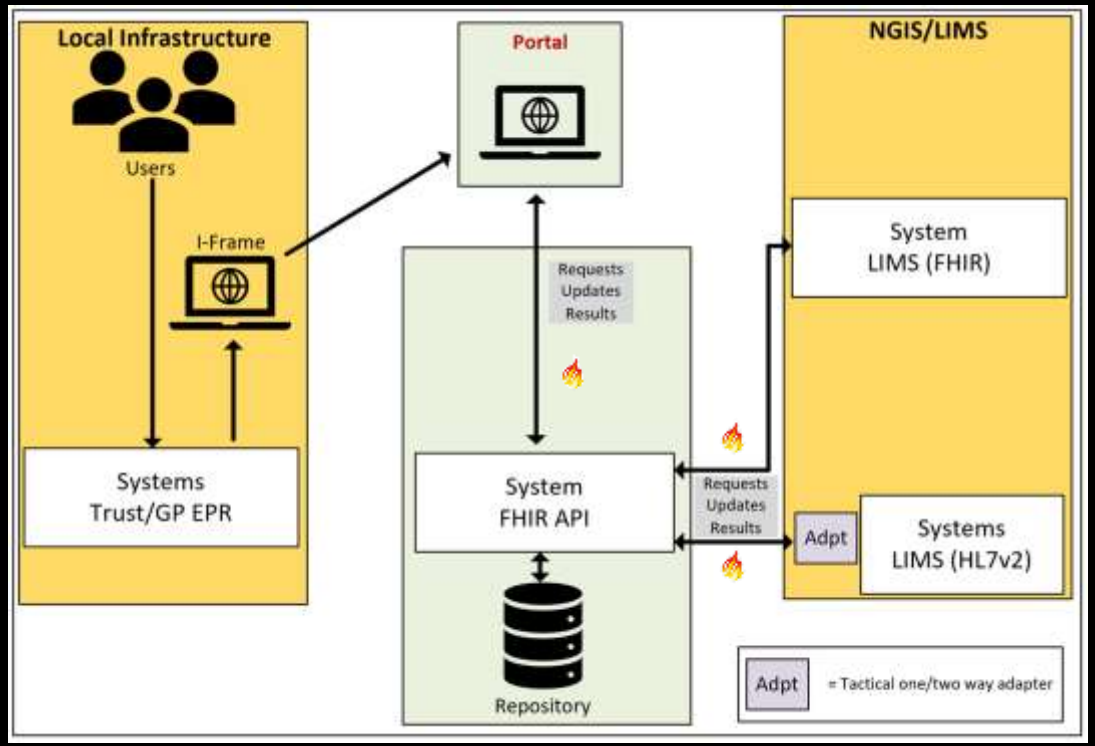
Proposed Options: Option One

Direct Access via Portal: requestors will be provided with secure access to manage the genomics test ordering process using a portal



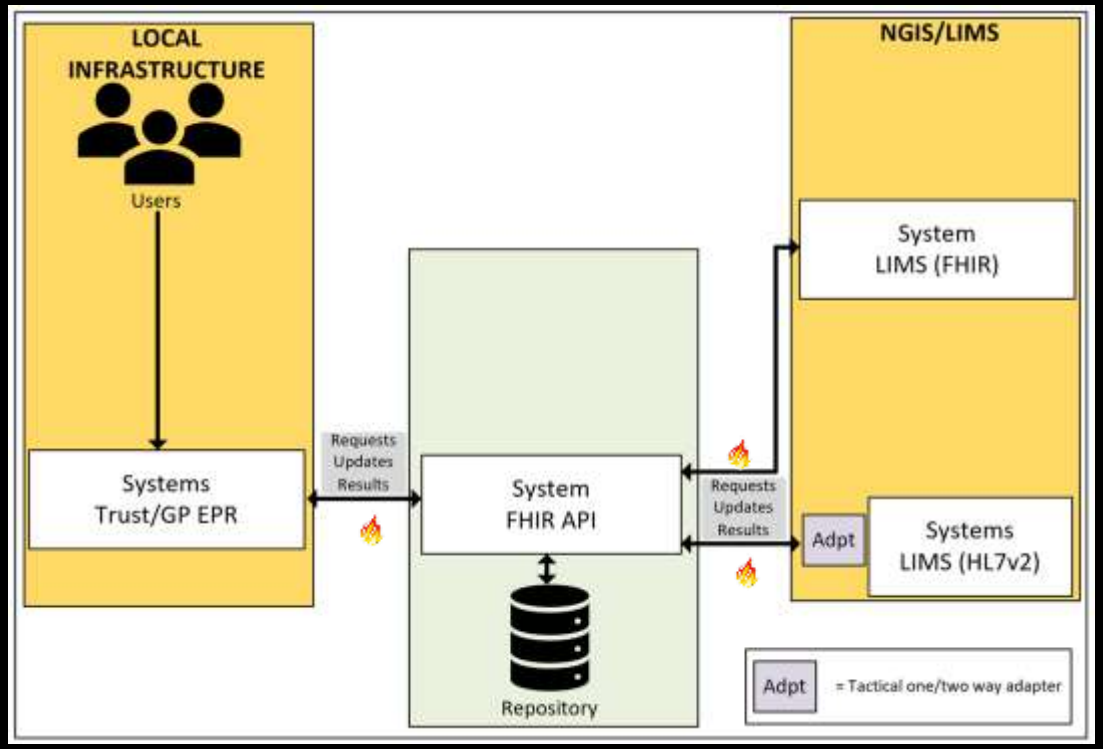
Proposed Options: Option Two

Direct access via IFrame integration: Requestors will have the ability to launch the portal in context via local system (EPR/ GP System)



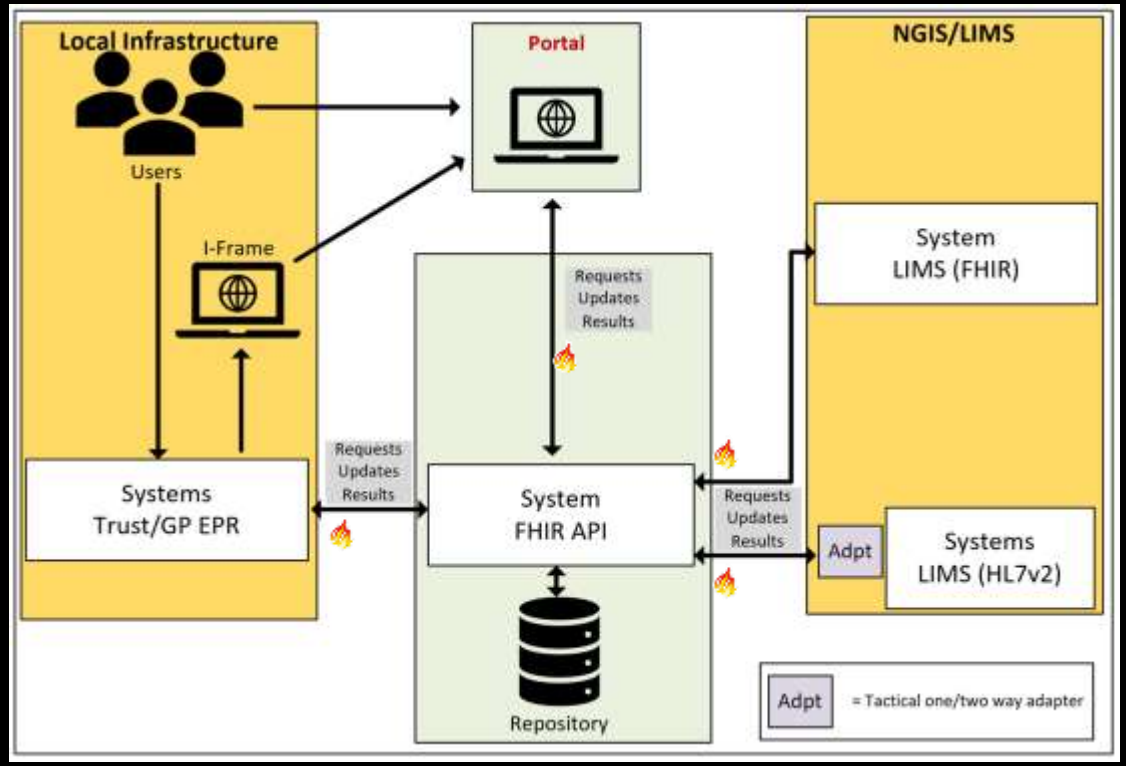
Proposed Options: Option Three

Fully integrated messaging via local requesting system: requestor to order genomic test electronically via local system without the use of the test order web portal



Proposed Options: Option Four

Fully integrated messaging via local requesting system or via portal: requestor to order genomic test electronically via local system alongside the use of the test order web portal



NHS England

WHAT WE NEED / NEXT STEPS...

CAPABILITY

AVAILABILITY

INTEREST

GENERAL THOUGHTS


NHS
England
Contact