Newborn Genomes Programme

Continuing the conversation about offering whole genome sequencing (WGS) to all newborns
This document shares the joint NHS England and NHS Improvement (NHSE/I) and Genomics England vision for the Newborn Genomes Programme, developed following our public and expert dialogues. It outlines initial design themes, and the iterative, collaborative approach we will take over the coming years.

The Newborn Genomes Programme will co-design and run an ethics-approved research pilot embedded in the NHS to explore the benefits, challenges, and practicalities of offering whole genome sequencing (WGS) to all newborns to accelerate diagnosis and access to treatments for rare genetic conditions. The programme will aim to:

1. Evaluate the utility, feasibility, and impact of genome sequencing for a larger number of childhood-onset rare genetic conditions in newborns, including what support they will need.
2. Understand how, with consent, the genomic and health data could be used for research to enable new diagnostic discoveries and treatments to be developed.
3. Explore the potential risks, benefits, and broader implications of storing an individual’s genome over their lifetime.

The NHS research pilot will align clinical care with research and will feed back support they will need.

Our work in offering WGS to all newborns will focus on understanding and evaluating if and how the following potential benefits can be achieved:

1. Early diagnosis and care for childhood-onset rare genetic conditions

   - Postnatal screening only
   - Actionable, childhood-onset conditions only

   Building on the principles of the NHS newborn screening programme, up to 200,000 babies’ genomes will be sequenced and analysed for a set of actionable genetic conditions which may affect their health in early years. This aims to ensure timely diagnosis, access to treatment pathways, and enable better outcomes and quality of life for babies and their families.

   We will work with parents, individuals with a rare genetic condition, multi-professional NHS workforce and experts to co-design future care and support pathways, the feasibility of delivery, and how they will be implemented and resourced, and to develop the principles to define actionability and which conditions to include.

2. Enabling research and new treatments for NHS patients

   With parents’ consent, babies’ genomes could be de-identified and added, alongside their health data, to Genomics England’s Research Environment. This will enable carefully vetted academic, clinical, and life sciences researchers to improve our understanding of health and disease, develop new diagnostics and treatments, and understand how current therapies can be improved or repurposed.

   Storing babies’ genomes securely, regardless of their newborn screening outcome, could allow them to be reanalysed as needed, potentially enabling access to new developments in genomics throughout their lifetime.

   We will explore the benefits as well as the ethical and practical implications of storing participants’ genomes, how and when it’s appropriate for participants’ data to be reanalysed in accordance with their choice, and the impact on them and their future clinical care.

3. Exploring the potential of a lifetime genomic record

   Genomics is transforming our healthcare system, enhancing our ability to provide personalised care, with so much more to discover.

   By establishing the clinical pathways for WGS in newborn babies, this groundbreaking programme will evaluate such an approach for its benefit and impact, with a view to incorporating it into the standard NHS offer in a safe and effective manner, providing a supportive experience for families.

   Having worked with children with rare diseases for over a decade, this really is a unique opportunity to add years to life, and life to years, whilst facilitating research to continually enhance care across all disease groups.

   I am heartened to hear that the programme will have the necessary time to consider potential patient journeys, and consider equity of access and family support.

   The public dialogue demonstrated that people see the potential power of genome sequencing but want us to get this right, from the very start. Co-designing the pilot with patients, families, and clinicians will ensure that we understand their needs and concerns, and act on experience. This is a really exciting and powerful opportunity.

Sarah-Jane Marsh
Chair, Newborn Genomes Programme
NHS Steering Group
CEO, Birmingham Women’s and Children’s NHS Foundation Trust

Rebecca Middleton
Vice-Chair, Participant Panel,
Genomics England
WHY NOW?

Today

Working in partnership to deliver the 100,000 Genomes Project and the NHS Genomic Medicine Service, NHSE/I and Genomics England have established the infrastructure to support WGS diagnostic and treatment pathways for children and adults with symptoms, and developed the sequencing and analytical pipelines to ensure a safe and effective service.

For many individuals with rare conditions and their families, WGS has brought an end to the diagnostic odysseys that they had been on – providing more certainty and choice. It has demonstrated the life-changing potential of using genomic medicine in healthcare.

Jessica’s story

Jessica was born with GLUT1 deficiency syndrome, which affects her movement, general development, and causes epilepsy.

It took years to find a diagnosis for Jessica - a diagnostic odyssey which included MRI scans under general anaesthesia, lumbar punctures, and EEGs.

Taking part in the 100,000 Genomes Project enabled her diagnostic odyssey to end, allowing her parents and doctors to focus on helping her live a healthier life.

“If we had this done when Jessica was born and found out the results straight away, we would have been on the right track immediately.”

Jessica’s Mum

Tomorrow

We want to build on these strong foundations. Considering our increased understanding of the links between the genome and health, as well as the analytical and healthcare capabilities we have already developed in WGS and the NHS, we believe now is the time to explore extending this life-changing potential to newborns.

Providing WGS for newborns could help transform diagnostic odysseys like Jessica’s, ensuring babies get access to appropriate treatments and interventions much earlier. It could also enable researchers to discover and develop new ways to use genomic medicine to help treat and save lives – and it could usher in a future of personalised, preventative healthcare.

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While earlier diagnosis can feel life-changing, tailored intervention may have the potential to limit or prevent conditions from progressing altogether.

By aligning clinical care with research, we hope to accelerate the discovery, development, trial, and approval of treatments for clinical use in the UK. Examples of rare genetic conditions for which therapies are already being trialled or used include:

- Duchenne muscular dystrophy: Translarna helps some children produce a protein essential to muscle development, when they would otherwise develop progressive weakness
- RPE65-mediated retinal dystrophy: Luxturna improves vision in children who would otherwise experience progressive, irreversible vision loss
- Haemophilia A: Roctavian increases the production of a protein needed for the blood to clot, and reduces the need for regular replacement therapy

*conservative number based on an assessment of the potential of WGS as a screening test in newborns, by the Genomics Analysis in Children Task and Finish Group.

Every year 3,000+ babies could benefit from life-saving or life-changing interventions thanks to WGS*
Our engagement efforts so far

We have been working with a diverse range of communities and groups to understand the ambitions, benefits, and challenges for a pilot. We will continue to work with them to explore these and to define the key themes and questions we need to look at when designing the pilot.

Public dialogue
Together with the UK National Screening Committee, we commissioned an in-depth national dialogue involving over 130 members of the public from a range of backgrounds and places within the UK, including individuals with genetic conditions, new/expectant parents, ethnic minorities, and young adults.

This initial piece of work found high levels of support and excitement for a pilot, and uncovered some concerns which were fed into our vision. The report and findings were launched in July 2021 at an event attended by over 1000 members of the public.

NHS Steering Group
The NHS Steering Group was established to support and develop the programme and its design, and understand the implementation considerations necessary to support the potential rollout of a NHS Newborn WGS service.

The group shares ideas, concerns, and expectations as key themes are developed for the design and potential rollout of the pilot.

The list of NHS Steering Group members is on page 10.

Expert interviews
We have interviewed a number of communities with expertise across maternity healthcare, genomic healthcare, ethics, and people with lived experience in order to road-test the vision and define initial design themes to prioritise.

Our approach
A collaborative and iterative way forward

We will keep talking and listening to the public and experts in a dialogue regarding the most appropriate uses of WGS in newborns.

At the same time, we’ll collaborate with parents, individuals with a rare genetic condition, and professional experts to co-design key elements of the process and ensure equitable access for all communities.
Our dialogues with the public and experts have highlighted some initial themes to prioritise in the co-design and feasibility phase:

**The benefits, limitations, and unknowns of WGS as a screening tool**

The potential of WGS for screening is enormous, but there are questions remaining:

- How it will integrate with the NHS newborn screening blood spot test
- How conclusively it can predict disease in pre-symptomatic babies, and how it impacts their diagnostic experience
- How it should be paired with other screening and diagnostic tools
- How to best guide parents through that uncertainty to avoid unnecessary ‘medicalisation’

“Up until recently we have started with signs/symptoms and used genomics to confirm a diagnosis. In newborn screening we start with a genome and try and interpret what symptoms a baby might develop. Given the 4 million or so variants per genome that need to be filtered, this inverted approach is likely to be more difficult than it sounds.”

**Clinical Geneticist**

“I used to be quite scared that people would be uncomfortable with the notion of uncertainty, but in my experience, if you are upfront and honest with them, they understand.”

**Genetic Counsellor**

**Co-developed principles for including conditions in the screening panel**

The logic behind which conditions are included in the initial panel of conditions we will screen for must be developed in a transparent and equitable way, with the active involvement of rare disease communities as well as experts.

“By only looking at clinical markers of severity, you don’t get the lived experience, which is ultimately what the parents are interested in. What is my child’s life going to be like? The expert knowledge [patients] have is really important to include.”

**Professor of Social Science in Medicine & Genomics**

“The most important word is ‘improved outcome’. What counts as an appropriate treatment and what we mean by actionability are going to be central themes in the programme.”

**Clinical Geneticist**

**Person-centred consent across screening, research, and reanalysis**

We need to set the bar to ensure all parents are empowered to make informed choices in terms of opting into the programme and understanding what it entails - and how their children will be able to make their own choices too.

“Pregnant women already have a tsunami of information coming toward them. Genomics is difficult for many people to understand, it will need more than just giving them written information.”

**Obstetrician**

“At the beginning [of the 100,000 Genomes Project], lots of people signed up for additional findings - but then life happens. It’s important that reanalysis is not just based on clinical care but takes into account the patient’s appetite for knowledge at that time. We must ensure the patient is in the driver’s seat at all times.”

**100,000 Genomes Project Participant, Adult Rare Disease Patient**

**A supportive and inclusive experience for all families**

It’s crucial that we design the end-to-end experience thoughtfully and inclusively, so that parents and children aren’t overwhelmed and always know where to find support, no matter their background or screening outcome.

“Very much part of getting to know that family is understanding their culture, ensuring that we are led by them in terms of what their needs are, but also advocate for the child by linking them with the experts or specialists that they need.”

**Health Visitor**

“I am a firm believer that emotional support is most effective from someone who has experienced the emotional turmoil that a patient’s family is feeling. On completion of genetic counselling, ongoing support and follow-up could be carried out by that particular group, e.g. cystic fibrosis group.”

**Public Dialogue Participant, Genetic Conditions Group**

**Trusted and future-proofed genomic data storage and usage**

People see the potential in the re-analysis of genomic data for healthcare purposes throughout an individual’s lifetime. However, it’s crucial we ensure the public trusts that their data is appropriately used and safe-guarded, and define together what it means to future-proof it.

“Genomics England’s current method of having deliberative discussion on whether or not to provide access to the [research] environment, and how that access is provided - both of those are jewels in the crown of the process.”

**Genetic Alliance UK**

“In the future, you might build in a regular review: if the child is a certain age, you’re looking for a spectrum of conditions likely to arise at that age. And obviously, once the child is mature enough to make their own decision about taking part, you’ve got the issue around re-consenting.”

**Health Policy Researcher**

**A sustainable and scalable programme for the NHS**

Considering existing pressures in healthcare, the programme must understand the services and resources required to support children and families, and education and training needs for the workforce to provide high quality care.

“As a midwife I would want to have clear guidance on what I need to discuss with a woman. What resources can we give them, where can I signpost them to find answers?”

**Midwife**

“What will provide much better quality of care is making sure that the clinical pathways and the guidance are very robust. If a condition won’t appear until a child is 8 or 10, we need to know exactly what symptoms might come with that condition, what referrals might be needed and when.”

**General Practitioner**
## Going Forward

### Public and rare disease interest groups
- A representative sample of new parents, patients with rare genetic conditions, 100,000 Genomes Project Participant panel members

### Royal Colleges
- Midwives, GPs, Paediatrics and Child Health, Nursing, Physicians, Obstetricians and Gynaecologists

### Healthcare professionals
- Health visitors, midwives, neonatal nurses, GPs, paediatricians, genetic counsellors, clinical geneticists, clinical scientists

### NHSE/I, Maternity and Child Services, Diagnostic services
- Various teams

### Ethics experts

### UK National Screening Committee

### Genomic Laboratory Hubs & Genomic Medicine Service Alliances

### Healthcare researchers
- Academic, clinical, and healthcare industry

## NHS Steering Group

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<thead>
<tr>
<th>Role</th>
<th>Name</th>
<th>Organization</th>
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Stay in touch

Find out more at: www.genomicsengland.co.uk/newborns

If you would like to discuss the programme in detail, please contact ge-newborns@genomicsengland.co.uk