Ethical Preparedness in Genomic Medicine (EPPiGen): project findings

Overview for policymakers

brighton and sussex medical school

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KEY MESSAGES

- Public announcements on the role of genomics in healthcare have strongly emphasised the transformative potential of genomic medicine. Our ability to generate genomic data, however, is currently well ahead of our ability to understand what that data may mean for people's health and people's lives.

- There is a significant disconnect between public discourse around genomics and patients' lived experiences of genomic medicine. It is important to ensure that expectations of what can be achieved through genomic data are grounded in the experiences of patients and health professionals. The methodologies described in this report offer valuable ways for patients, parents and families to convey to health professionals and policymakers the emotional realities of their lived experiences, both inside and outside the clinic.

- Participation in genomic testing can offer the possibility of personalised treatments or access to support. However, for many, a diagnosis or label does not necessarily provide clarity or actionable outcomes, leaving families with ongoing uncertainty. Better support is required to prevent families 'falling through the gaps' in service provision.

- Parents of children with genetic conditions want to be able to share a rounded picture of their child's lived experience with professionals, receive recognition as key members of the 'team' caring for and supporting their child, and be supported by better co-ordinated systems.

- Genomic testing challenges the traditional concept of the individual 'patient', as multiple family members – both biological and non-biological – are often deeply involved. Policy initiatives must acknowledge and incorporate this collective experience to provide better patient and family support.

- Germline genomic testing provides 'immortal data' that do not change across time and may have relevance for relatives and generations far beyond the patient's own lifespan. This raises multiple ethical challenges for patients, families and health professionals in relation to interpreting and communicating genetic findings.

- Health professionals need help and support in preparing for and delivering health care innovations which goes beyond medical and technical education and training to incorporate expertise and confidence in addressing ethical considerations.

- Genomic medicine and research will continue to raise ethical issues. We define ethical preparedness as "a state from which one is able to identify and articulate ethical issues in a timely and ongoing manner". This requires both families and professionals to have the tools and the skills/experience available to address ethical challenges as they arise in their own lives and practice. As a minimum they must have access to appropriate expertise, whether through professional or regulatory bodies, or through adequately funded peer support groups.

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ABOUT EPPiGen

Advances in genomic technologies have raised the possibility of improvements in our understanding of health and disease. Enthusiasm about improved diagnoses and treatments has been accompanied by high levels of political and financial investment in a 'genomic future'.

Funded by a Wellcome collaborative award between 2018 and 2025, the 'Ethical Preparedness in Genomic Medicine' (EPPiGen) project sought to understand some of the ways that these advances impact (a) the people seeking a genetic diagnosis, and their families and (b) the health professionals utilising or delivering these new technologies. We wanted to explore some of the consequences for healthcare practices, systems, and professionals, and their ability to incorporate genomic technologies and genomic information into mainstream medicine. What is required for these various parts of the health system to be *prepared* so that those using the system are better supported? And as an essential element of that preparedness, how can all concerned be prepared to recognise and respond to the *ethical* challenges that inevitably arise when introducing new health technologies into mainstream healthcare provision?

This project has examined how the promise and challenge of genomic medicine is understood and experienced by those providing and engaging with the service, starting from the premise that the successful integration of genomic technologies will require more than governance and off-the-shelf rules and regulations.[1] EPPiGen has brought together collaborators with many different areas of expertise to combine empirical bioethics research, conceptual and theoretical analysis, and professional and public engagement to examine the concept of *ethical preparedness* in the context of genomic medicine.

BOX 1

In part in response to the annual report of the Chief Medical Officer, launched in 2017, which called for "genomics to be available to more patients" we wanted to ask how health professionals and patients do, and should, respond to new and challenging interactions - be they scientific, structural, medical or interpersonal. By asking the question 'are we prepared for this and what if any are the ethical barriers to the delivery of genomics in a health service', we wanted to:

- provide insights that make a practical difference to health professionals, patients, publics and policymakers;
- create spaces and opportunities for all those involved in the genomic medicine journey to identify and reflect upon the challenges entailed;
- develop the field of empirical bioethics through complementary experiences and leave a legacy.

1. Samuel, GN, Farsides, B. Public trust and 'ethics review' as a commodity: the case of Genomics England Limited and the UK's 100,000 genomes project. Med Health Care and Philos. 2018;21:159–168. https://doi.org/10.1007/s11019-017-9810-1

This report provides an overview for policymakers of the findings of the many strands of research conducted by the EPPiGen teams [2] (sections 2–4) and proposes an ethical framework and recommendations to support policymakers, health and research institutions, practitioners, and patients and their families (sections 5-6). An overview of the diverse methodologies and methods used is provided in Appendix 1; a list of all academic outputs to date in Appendix 2; and an overview of engagement and dissemination to date in Appendix 3. In brief, research activities on which this project overview draws included research with:

Patients and families who have engaged with genomic medicine

for example through the 100,000 Genomes Project, the Deciphering Developmental Disorders study, or through NHS genomic medicine services. This included a 5-year qualitative longitudinal study with patients and families; co-produced qualitative research with parents of children with rare conditions, drawing on individual and collective creative activities; and a mixed methods study exploring how participants in the 100,000 Genomes Project experienced the consent process.

Health professionals

including studies exploring the perspectives of GPs on developments in genomic medicine; clinical geneticists' perspectives on ethical decision-making and how this could best be fostered; ethical challenges in laboratory practice; illustrative case studies from clinical practice in conceptual research; and health professionals' perspectives on race and ethnicity in genomics.

Publics

including a public survey on the publics' views on the ethical issues raised by genome sequencing, a collaboration with Mass Observation to ascertain public perspectives, and analysis of newspaper articles and stock images relating to genomics.

2. Note that at the time of writing some data are still being analysed and further articles will be published under the banner of EPPiGen in due course.

2.1 Developments in genomics

Genomics involves the study of a person's entire genetic code (the genome) in order to understand how variation in a genome might influence health or disease. Whole genome sequencing (WGS), which was unaffordable in routine practice until ten years ago, involves the sequencing of all 3 billion DNA 'letters' of a person's genetic code. Each individual's whole genome sequence will contain around 5 million variants when compared with a standard 'reference' genome. These variants are then filtered to 'shortlist' genetic variants that are likely to be most relevant, depending on the reasons for the analysis. Particular signs or symptoms, or family history, for example, might prompt scrutiny of particular genetic variants or sections of the genetic code.

Although a person's genome can now be sequenced relatively quickly and cheaply, understanding the implications of particular genetic variants for a person's health often remains complicated. While a small number of serious health conditions are directly linked to one or more specific genetic variants, most health conditions are multifactorial, involving genetic, developmental, environmental and lifestyle factors.

Moreover, genomics is still a developing science, and the knowledge base is constantly evolving. A genetic variant may, for example, be described as a 'variant of uncertain significance' (VUS) because it is not known whether it is linked to a particular diagnosis. In some cases, a variant may be categorised as a VUS simply on the basis that it has not been observed before. In other cases, a link between a variant and a health condition may be well-established, but having the variant may lead to different clinical effects in different people (variable expressivity) or only cause the condition in some people (reduced penetrance). In the context of rare genetic conditions of childhood, for example, knowledge about penetrance at population level is currently very limited, because what is known about these variants is based on finding them in children who are already experiencing significant symptoms. [3]

What are believed to be well-established associations between a variant and a particular medical condition may also, over time, be overturned, as more is learned about the wide range of genetic variation across the globe. For example, genetic variants (rare in European datasets) thought to cause hypertrophic cardiomyopathy have been found to be so common globally that it is highly unlikely that they are linked with disease. [4] Given these complexities, EPPiGen researchers have emphasised how **our ability to generate genomic data is currently well ahead of our ability to understand what they mean for people's health and people's lives**. [5]

3. Horton R, Wright CF, Firth HV, Turnbull C, Lachmann R, Houlston RS et al. Challenges of using whole genome sequencing in population newborn screening. BMJ. 2024; 384:e077060. https://doi.org/10.1136/bmj-2023-077060.
4. Hardcastle F, Lyle K, Horton R, et al. The ethical challenges of diversifying genomic data: A qualitative evidence synthesis. Cambridge Prisms: Precision Medicine. 2024;2:e1. https://doi.org/10.1017/pcm.2023.20, citing Manrai et al (2016)
5. Horton R, Lucassen A. Ethical considerations in research with genomic data. The New Bioethics. 2023;29(1):37-51. https://doi.org/10.1080/20502877.2022.2060590

As the example of global variation cited above illustrates, there are also real risks that the historic lack of diversity among participants in genomic research, and the resulting over-representation of people of Northern European ancestry in the data held in reference databases, will 'bake in' inequality. A review of the evidence on the ethical challenges of diversifying genomic data, conducted as part of EPPiGen, highlighted how addressing these concerns and ensuring a more inclusive approach to research participation is not straightforward [6]. In addition to recognising how past abuses remain relevant today (as expressed, for example, in heightened concerns relating to the possible (mis)uses of research data and scope for unjust profiteering), it is also crucial to recognise how structural barriers to equitable participation continue to exist, including ongoing inequities of access to health services and hence to the benefits of health research.

Interpreting genomic results: art as well as science?

Recognising these inherent uncertainties in the interpretation of genomic data, EPPiGen researchers developed a fictional example to highlight that results usually do not leap out of a genetic code but require contextual interpretation. This was first explored at a science festival where attendees explored the challenges of interpreting genomic results in a way that would be meaningful to, and useful for, a fictional 14-year-old boy, with muscle problems (Ben). This activity was later developed into a research paper for a journal for young people. [7]

Interestingly there was strikingly little consensus among visitors to the science festival as to what should constitute Ben's 'result'. Some visitors thought none of the variants identified through WGS seemed relevant enough to Ben's condition to be worth reporting to him, while some wanted to include nearly all the variants they had studied. Researchers concluded that "**sorting through the 'building blocks' of life ended up feeling more like interpreting abstract art, with different people seeing and valuing different aspects**." [8]

6. Hardcastle F, Lyle K, Horton R, et al. The ethical challenges of diversifying genomic data: A qualitative evidence synthesis. Cambridge Prisms: Precision Medicine. 2024;2:e1. https://doi.org/10.1017/pcm.2023.20
7. From Horton R, Lyle K, Weller S, Ballard L, Lucassen A. Genomic data: building blocks for life or abstract art? Front. Young Minds. 2024;12:1249534. https://doi.10.3389/frym.2024.1249534
8. Horton R, Lyle K, Weller S, Ballard L, Lucassen A. Genomic data: building blocks for life or abstract art? Front. Young Minds. 2024;12:1249534. https://doi.10.3389/frym.2024.1249534

2.2 The political and commercial context

A review by EPPiGen researchers explored how 'genomic futures' are imagined and presented in public policy documents. [9] Public announcements on the role of genomics in the NHS have strongly emphasised the transformative potential of genomic medicine, along with the need to address ethical challenges such as equity of access and appropriate approaches to data sharing. There has, however, been relatively little accompanying public discussion about the uncertainties and complexities that are also involved. Influential statements from the then Chief Medical Officer in her 2016 report *Generation Genome*, and from government ministers in the 2020 Office of Life Sciences report *Genome UK*, for example, include:

> Genomics is not tomorrow. It's here today. I believe genomic services should be available to more patients whilst being a cost effective service in the NHS... now we need to welcome the genomic era and deliver the genomic dream. [10]

> We will help people live longer, healthier lives by using new genomic technologies to routinely identify the genetic determinants of rare diseases and cancer. We will detect cancers earlier, and we will provide personalised treatments to illness. [11]

Another strand of EPPiGen research has explored how health care boundaries are changing through, for example, direct to consumer genetic testing, and how the marketing of these tests can act to reinforce these kinds of positive political messages about the capacity of genomic information to provide clear information and empower people to take control over their own health.[12] The technical images widely used to illustrate genetic testing (such as brightly-lit bands of DNA produced by gel electrophoresis) may also act to reinforce the idea that testing is precise, unambiguous and illuminating. [13]

9. Mwale S, Farsides B. Imagining genomic medicine futures in primary care: General practitioners' views on mainstreaming genomics in the National Health Service. Sociol Health Illn. 2021 Nov;43(9):2121-2140. https://doi.org/10.1111/1467-9566.13384
10. Davies 2016, cited in Mwale S, Farsides B. Imagining genomic medicine futures in primary care: General practitioners' views on mainstreaming genomics in the National Health Service. Sociol Health Illn. 2021 Nov;43(9):2121-2140. https://doi.org/10.1111/1467-9566.13384
11. Genome UK – cited in Mwale S, Farsides B. Imagining genomic medicine futures in primary care: General practitioners' views on mainstreaming genomics in the National Health Service. Sociol Health Illn. 2021 Nov;43(9):2121-2140. https://doi.org/10.1111/1467-9566.13384
12. Horton R, Crawford G, Freeman L, Fenwick A, Lucassen A. Direct-to-consumer genetic testing with third party interpretation: beware of spurious results. Emerg Top Life Sci 27 November 2019; 3(6):669–674. https://doi.org/10.1042/ETLS20190059. Shkedi- Rafid S, Horton R, Lucassen A. What is the meaning of a 'genomic result' in the context of pregnancy?. Eur J Hum Genet. 2021;29:225–230. https://doi.org/10.1038/s41431-020-00722-8
13. Horton R, Boyle L, Weller S et al. Glowing gels and pipettes aplenty: how do commercial stock image banks portray genetic tests? Eur J Hum Genet. 2023. https://doi.org/10.1038/s41431-023-01508-4

2.3 Public knowledge and attitudes to genomic data

A survey commissioned by EPPiGen of nearly 2,000 public respondents demonstrated correspondingly positive attitudes to genomic data, and a lack of awareness of the uncertainties associated with genomic findings. Respondents associated genomics mainly with terms such as 'helpful', 'informative' and 'personal'; very few respondents selected descriptors such as 'needle in a haystack' or 'messy'.[14] Another strand of this project interviewed people who had taken part in the 100,000 Genomes Project and found that many participants over-estimated the likelihood that they would receive a diagnosis through such testing. [15]

These studies also explored attitudes to sharing the information from genomic tests with relatives, for whom such information might also be relevant. Respondents to the public survey expressed strong support for relatives to have access to information that could be of relevance to their health although they were divided about whether this was the role of the patient or the health professional. Participants in the 100,000 Genomes Project had also been asked about whether they would want their genome searched for 'additional findings' (other predispositions to disease detected incidentally). Respondents often did not recall precisely what had been discussed, or what they agreed to in consent discussions but expected health professionals to let them know about any relevant information found in this process.[16] Despite not recalling the precise content of consent conversations or possible complexities, participants expressed high levels of trust and confidence in the consent process, in the professionals involved, and in the system. [17]

2.4 Responding to complexity and uncertainty in genomics

The inherent uncertainties and complexities in interpreting what these technological developments mean for people's health can lead to challenging ethical dilemmas for patients and health professionals alike. These include how genomic information relevant to others in a family can be meaningfully and sensitively shared; and how complex and uncertain results can and should be communicated. However, they also raise 'bigger picture' ethical concerns with respect to the hopes and expectations – even promises – associated with the UK's substantial financial and political investments in genomic medicine. [18] Such concerns cannot be addressed by individual practitioners but need to be tackled at the levels of policy and systems, so that public policy statements do not raise unrealistic expectations, and health professionals are supported by their organisations in provide the responsive, sensitive care they aim to offer. They include:

14. Ballard LM, Horton RH, Fenwick A, Lucassen AM. Genome sequencing in healthcare: understanding the UK general public's views and implications for clinical practice. Eur J Hum Genet. 2020 Feb;28(2):155-164.
15. Ballard LM, Horton RH, Dheensa S et al. Exploring broad consent in the context of the 100,000 Genomes Project: a mixed methods study. Eur J Hum Genet. 2020;28:732–741. https://doi.org/10.1038/s41431-019-0570-7. Even in people strongly suspected of having a genetic condition, the diagnostic rate will usually be less than 25%.
16. Ballard LM, Horton RH, Fenwick A, Lucassen AM. Genome sequencing in healthcare: understanding the UK general public's views and implications for clinical practice. Eur J Hum Genet. 2020 Feb;28(2):155-164. https://doi.org/10.1038%2Fs41431-019-0504-4
17. Ballard LM, Horton RH, Dheensa S et al. Exploring broad consent in the context of the 100,000 Genomes Project: a mixed methods study. Eur J Hum Genet. 2020;28:732–741. https://doi.org/10.1038/s41431-019-0570-7
18. Gorman R, Farsides B. Writing the worlds of genomic medicine: experiences of using participatory-writing to understand life with rare conditions. Medical Humanities. 2022;48:e4. https://doi.org/10.1136/medhum-2021-012346

- **The crucial distinction between the likely future *public* benefits of enhanced scientific knowledge and immediate *benefit to individuals* now**. Improving scientific understanding of the connections between particular genetic variants and health conditions will undoubtedly be of value in improving human health over the long-term. However, the benefit that any one individual may currently gain from WGS is much more uncertain. Individual benefit is particularly uncertain if WGS is undertaken in the absence of existing symptoms. [19]

- **The uncertain value of genomic data in helping prevent or treat common health conditions** (whose causes are only partly genetic), in contrast with their recognised role in managing some rare conditions. [20]

- **The important distinction between genomic diagnosis** (testing those suspected of a having a condition) **and genomic screening** (testing populations of apparently healthy people to predict disease), which is not always well understood. While some uncertainties about the health-related implications of particular genetic variants may be resolved with further research, even with more definitive information the ability to predict disease from the presence of particular variants will remain weak in many cases. Many healthy adults, for example, have been shown to have genomic variants that do not cause the childhood diseases they were thought to predict. "**The wider we look, the more uncertainty we invite**." [21]

- Recognition that there may be **uncertainty as to whether a genomic approach is actually the most appropriate in particular contexts**, and being open to different approaches accordingly.

- Acknowledgement of the **economic importance of the genomic agenda**, with genomics featuring significantly in the UK's industrial plan as well as being key to NHS health planning. This can lead to challenges and tensions: part of being ethically prepared involves an acknowledgement of this possibility.

These issues are inextricably bound up both with the nature of genomic medicine itself, and with the associated challenges of integrating emerging technologies into existing healthcare systems. They cannot simply be 'solved' with off-the-peg solutions: rather, they highlight the need for ethical preparedness at professional, institutional and policy level in order to help ensure that the promises of the benefits to be gained from genomic developments can be achieved. It was the premise of the EPPiGen collaboration that the starting point for thinking about what ethical preparedness could look like should be an understanding of the impact of genomic medicine on those using it: both on the patients and their families seeking a genomic diagnosis and/or taking part in genomic research; and on the range of health professionals responsible for providing, or drawing on, genomic health services in the care they provide to patients and families. In the following two sections of this report, we present an overview of these aspects of our findings.

19. Horton R, Lucassen A. Ethical issues raised by new genomic technologies: the case study of newborn genome screening. Cambridge Prisms: Precision Medicine. 2023;1:e2. doi:10.1017/pcm.2022.2. https://doi.org/10.1017/pcm.2022.2; Horton R, Wright CF, Firth HV, Turnbull C, Lachmann R, Houlston R S et al. Challenges of using whole genome sequencing in population newborn screening. BMJ. 2024; 384:e077060. https://doi.org/10.1136/bmj-2023-077060.
20. Horton R, Lucassen A. Ethical considerations in research with genomic data. The New Bioethics. 2023;29(1);37-51. https://doi.org/10.1080/20502877.2022.2060590
21. Horton R, Lucassen A. Ethical issues raised by new genomic technologies: the case study of newborn genome screening. Cambridge Prisms: Precision Medicine. 2023;1:e2. doi:10.1017/pcm.2022.2. https://doi.org/10.1017/pcm.2022.2

Working closely with project partners with lived experience of genomic medicine services, EPPiGen drew on a variety of different approaches to explore patients' and families' experiences and insights (see Appendix 1 for details of the various methodological approaches). As described in our introduction, these included three groups of studies:

- A series of qualitative studies employing a range of creative methods co-produced with parents of children with rare conditions who have undertaken genomic testing.
- 'Journeys through genomics' – a 5-year qualitative longitudinal (QLR) study following the experiences of 25 people (patients, partners, parents, adult children) affected by the process and outcomes of genomic testing.
- 'Construction of 'results' from the millions of variants found in a genome' – a multi-faceted project exploring how and why variations in the genetic code are given the status of being 'results'.

3.1 Experiences of parents with children living with rare genetic conditions

An important part of EPPiGen involved ensuring that the experiences and knowledge of patients and their families should shape and inform the project findings on an equal basis with those of professionals and policymakers. EPPiGen therefore drew on a variety of creative approaches to help ensure that the project should speak 'with' rather than 'for' users of genomic services, including the use of diverse creative methods (writing and poetry workshops [22], stop-motion animation [23], collage [24], and postcards [25]) to enable the parents of children with rare genetic conditions who had enrolled in the 100,000 Genomes Project to tell their own stories (see Appendix 1 for details of methodologies used). Many of these outputs, in particular the poetry collection Helix of Love, have since been widely disseminated and are being used as tools to support and inform health professionals and as support for future participants and patients (see Appendix 3).

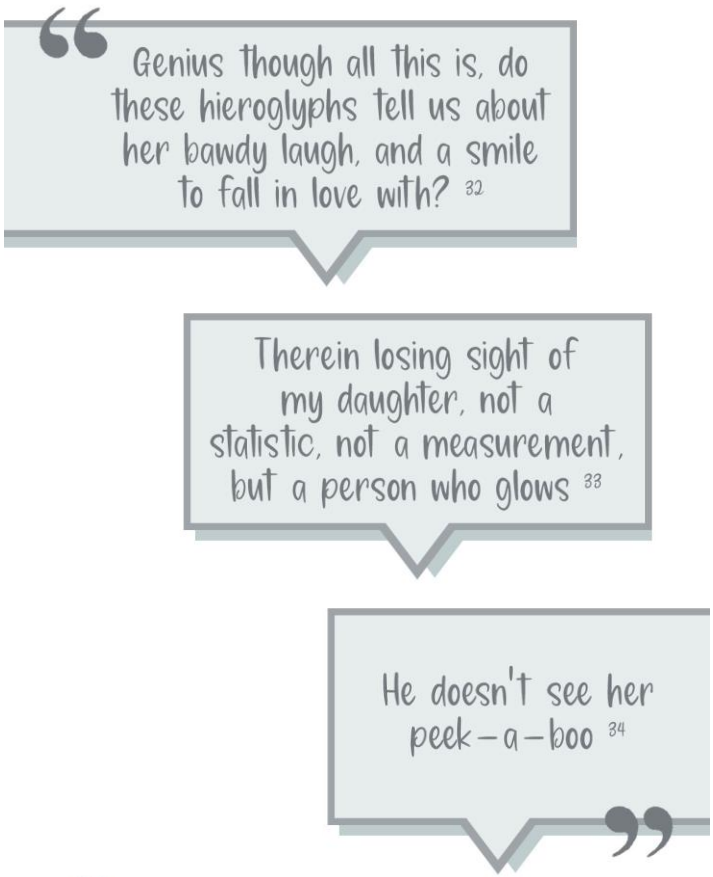
These approaches helped bring to the fore how 'the clinic' is only one part of the often complex, multi-layered lives of people living with genetic conditions, and how the potential contribution of genomics needs to be understood and interpreted in the much broader context of living interconnected lives, not simply 'being a patient'.

22. Gorman R, Farsides B. Writing the worlds of genomic medicine: experiences of using participatory-writing to understand life with rare conditions. Medical Humanities. 2022;48:e4. https://doi.org/10.1136/medhum-2021-012346; Helix of Love: a collection of poems from parents of children with rare genetic conditions, 2023.
23. Gorman R, Farsides B, Gammidge T. Stop-motion storytelling: Exploring methods for animating the worlds of rare genetic disease. Qualitative Research. 2023;23(6):1737-1758. https://doi.org/10.1177/14687941221110168
24. Ibid.
25. Gorman R, Farsides B. Mail art methods and the social and cultural geographies of families affected by rare disease. Social & Cultural Geography. 2024; 1–23. https://doi.org/10.1080/14649365.2024.2416672

The use of creative methodologies with parents of children with rare conditions enabled participants to evoke rather than have to explain emotions ('showing rather than telling'); [26] allowed for a degree of safety through permitting ambiguity of expression;[27] and helped make visible to professionals the everyday aspects of their lives that can be of far more importance than what happens in the clinic ("Nobody asks me this stuff"[28]). The use of novel approaches such as the opportunity to send postcards to the researchers at any point encouraged participants to identify issues of importance to them, at convenient times, on their own terms, and with minimal burden, even enjoyment ("it's more fun if you post things").[29] The conversations that took place between participants during the creative workshops, and in response to each other's creations (documented by the researchers), were as rich a source of insight as the final creative outputs themselves. [30]

Recurrent themes that emerged across the various different creative activities included:

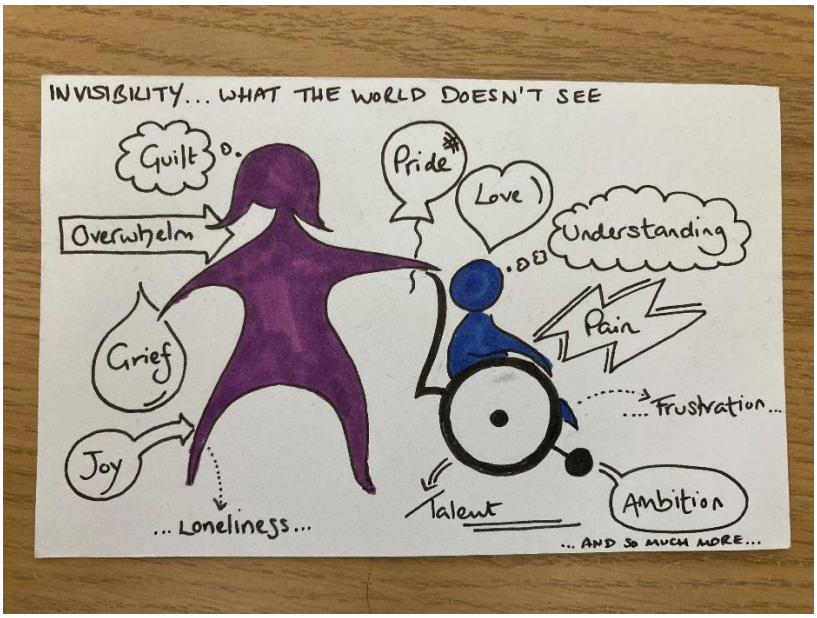
- The central **challenge of 'being heard'** by health professionals as the parent of a child with complex disabilities – and in particular of conveying how any particular medical issue needs to be considered in the **wider context of your child's life** ("hope, family, play, school, holidays" [31]).



26. Gorman R, Farsides B. Writing the worlds of genomic medicine: experiences of using participatory-writing to understand life with rare conditions. Medical Humanities. 2022;48:e4. https://doi.org/10.1136/medhum-2021-012346
27. Gorman R, Farsides B, Bonner M. Crafting representations of rare disease: collage as qualitative inquiry. Arts & Health. 2023. https://doi.org/10.1080/17533015.2023.2254328
28. Gorman R, Farsides B. Writing the worlds of genomic medicine: experiences of using participatory-writing to understand life with rare conditions. Medical Humanities. 2022;48:e4. https://doi.org/10.1136/medhum-2021-012346
29. Gorman R, Farsides B. Mail art methods and the social and cultural geographies of families affected by rare disease. Social & Cultural Geography. 2024; 1–23. https://doi.org/10.1080/14649365.2024.2416672
30. Gorman R, Farsides B. Writing the worlds of genomic medicine: experiences of using participatory-writing to understand life with rare conditions. Medical Humanities. 2022;48:e4. https://doi.org/10.1136/medhum-2021-012346 and others
31. Gorman R, Farsides B, Bonner M. Crafting representations of rare disease: collage as qualitative inquiry. Arts & Health. 2023. https://doi.org/10.1080/17533015.2023.2254328
32. Unpacking, Helix p30
33. See me here i am, Helix p31
34. The room, Helix p37

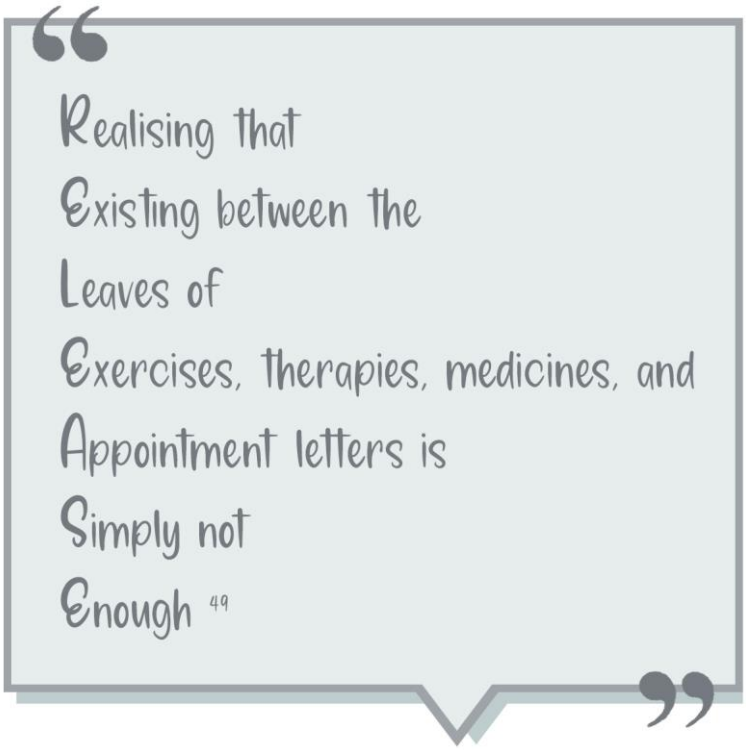
- The importance of "**sharing the good stuff that happens**", [35] including recognising that while "milestones might not be hit … inchstones will be celebrated". [36] This 'good stuff' includes bringing to the fore the agency of the participants' children. In an animation depicting a mother being mobbed by birds, for example, it is her child who comes as the hero to save her; [37] in a letter to her future self another mother writes: "your heart will break into pieces/ but she will help you put them back together again." [38]

> At my brother's wedding she held my hand when the absence of my late mother made me sad and overwhelmed. She chatted to me at bedtime and snuggled in tight. Since you last saw her, yes, I think she's doing alright. [39]

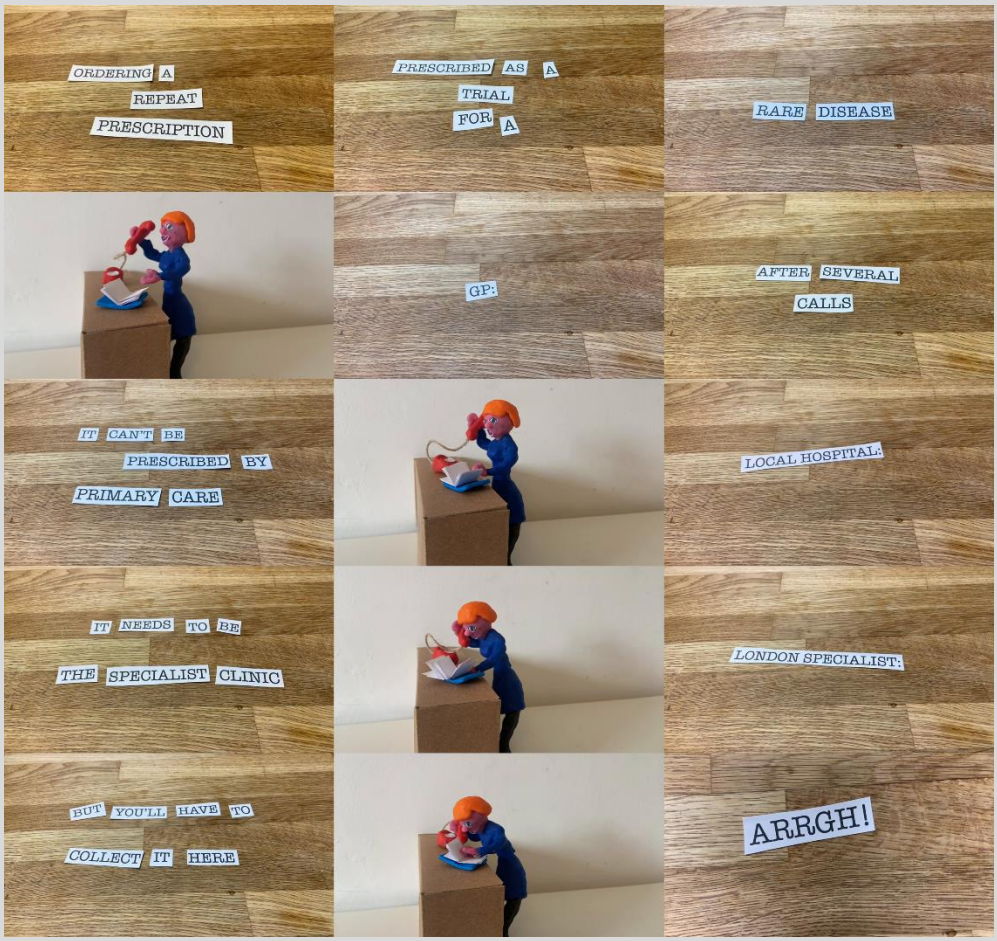


35. Gorman R, Farsides B. Writing the worlds of genomic medicine: experiences of using participatory-writing to understand life with rare conditions. Medical Humanities. 2022;48:e4. https://doi.org/10.1136/medhum-2021-012346
36. Letter, Helix, p13
37. Gorman R, Farsides B, Gammidge T. Stop-motion storytelling: Exploring methods for animating the worlds of rare genetic disease. Qualitative Research. 2023;23(6):1737-1758. https://doi.org/10.1177/14687941221110168
38. Letter, Helix, p13
39. about your child, Helix p29

- The **practical and emotional complexity of caring** for a child with very complex needs, including how that means you have to "put aside your sense of self", taking on the unchosen job of being "carer or a medical secretary" as well as a parent. [40] The toll this takes on parents, and the tension with other aspects of ordinary family life, is a common theme in the collages [41] and postcards [42], and reflected in many of the poems which capture "heaviness of living", [43] the "necessities of life that brim over", [44] and the "lost inner me". [45] Repeated reference is made to how the health system takes for granted that parents (particularly mothers) will take on this role of expert caregiver while at the same time being relegated, unregarded, to being "just mum": [46] by implication "just an unqualified woman". [47] Being passed from pillar to post within the different parts of the health system, for example when chasing crucial repeat prescriptions, adds unnecessarily to the invisible labour borne by parents. [48]



40. Gorman R, Farsides B. Writing the worlds of genomic medicine: experiences of using participatory-writing to understand life with rare conditions. Medical Humanities. 2022;48:e4. https://doi.org/10.1136/medhum-2021-012346
41. Gorman R, Farsides B, Bonner M. Crafting representations of rare disease: collage as qualitative inquiry. Arts & Health. 2023. https://doi.org/10.1080/17533015.2023.2254328
42. Gorman R, Farsides B. Mail art methods and the social and cultural geographies of families affected by rare disease. Social & Cultural Geography. 2024; 1–23. https://doi.org/10.1080/14649365.2024.2416672
43. The table, Helix p54
44. An unspoken weight, Helix p21
45. Lost, Helix p56
46. Gorman R, Farsides B, Gammidge T. Stop-motion storytelling: Exploring methods for animating the worlds of rare genetic disease. Qualitative Research. 2023;23(6):1737-1758. https://doi.org/10.1177/14687941221110168; Gorman R, Farsides B, Bonner M. Crafting representations of rare disease: collage as qualitative inquiry. Arts & Health. 2023. https://doi.org/10.1080/17533015.2023.2254328
47. Gorman R, Farsides B. Mail art methods and the social and cultural geographies of families affected by rare disease. Social & Cultural Geography. 2024; 1–23. https://doi.org/10.1080/14649365.2024.2416672
48. Gorman R, Farsides B, Gammidge T. Stop-motion storytelling: Exploring methods for animating the worlds of rare genetic disease. Qualitative Research. 2023;23(6):1737-1758. https://doi.org/10.1177/14687941221110168
49. Release, Helix p53



- The **gulf that may exist between the experience of families and routine professional practices in the health system**: illustrated through references to incomprehensible terminology [50] and lack of attention to important personal information, [51] with dismissive language such as "don't worry" being used to downplay concerns and brush off anxieties. [52] The harmful impact of inappropriate terminology such as "deformed'" or "anomaly" may stay with people for a lifetime.[53] Health professionals vary in their ability to cross that gulf and offer the supportive relationships that parents need to enable them to care for their child:

> I opened the door,
> A warm welcome comforting as tea and toast.
> I felt heard and at ease.
> With a consolatory shoulder tap,
> You wished me well on my way.
>
> I opened the door,
> Bright, white, stark.
> Thefamiliar smell of trauma.
> You made me hold her tight while she cried.
> Fear set in. [54]

50. Gattaca, Helix p35
51. Gorman R, Farsides B. Writing the worlds of genomic medicine: experiences of using participatory-writing to understand life with rare conditions. Medical Humanities. 2022;48:e4. https://doi.org/10.1136/medhum-2021-012346
52. Gorman R, Farsides B, Gammidge T. Stop-motion storytelling: Exploring methods for animating the worlds of rare genetic disease. Qualitative Research. 2023;23(6):1737-1758. https://doi.org/10.1177/14687941221110168
53. 17; 41 weeks, Helix p17
54. Appointments, Helix p41

- The **intrusion of healthcare on ordinary domestic life and spaces** in ways that can be both positive or negative: medical communications that may arrive at times or in ways that test resilience; the need to accommodate medications, care products and health devices in the family home (and the costs of running them); and the physical adaptation of the domestic space in ways that can be transformative but also the source of guilt or unease:

> You learn very early on in this journey that that clinicians don't call to tell you that they have nothing to tell you. He's left a number for me to call him but there's no reply. An evening of wondering ahead. [55]

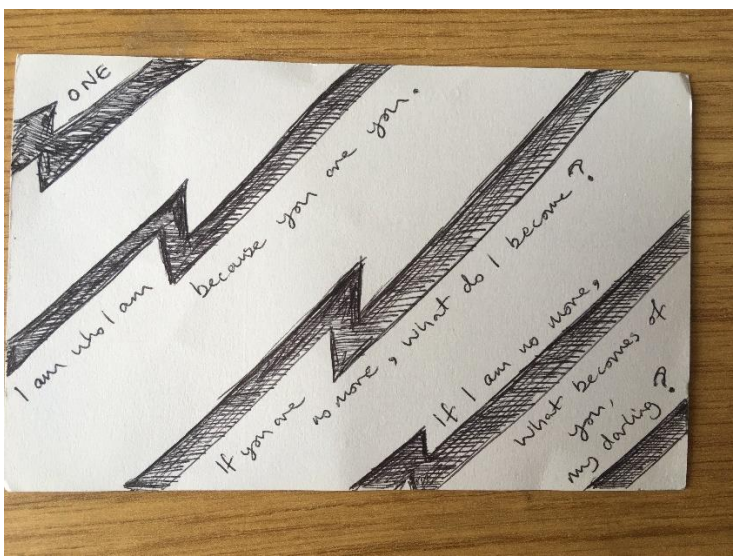
> Finally the wheelchair can be driven outside independently to a safe and fully accessible space I it's utterly bloody AMAZEBALLS! Still feel that we're not deserving or entitled to it and people will judge... [56]

- The importance of **practical help from immediate family,** and of **mutual support from other families** in similar situations, while recognising that one's identity as part of the "rare family" [57] may be contingent or threatened:

> Our son is safe with granny. I have nothing to do except bob, and bask, and breathe. [58]

> ...you'll find your tribe / who you'll chat to and they will know / as they've been where you are too [59]

> Do we belong here anymore?... Are we still part of the rare community? [60]



55. Gorman R, Farsides B. Mail art methods and the social and cultural geographies of families affected by rare disease. Social & Cultural Geography. 2024; 1–23. https://doi.org/10.1080/14649365.2024.2416672 (postcard 2b)
56. Ibid (postcard 2c)
57. Ibid.
58. Time out, Helix p50
59. Letter, Helix p13
60. Gorman R, Farsides B. Mail art methods and the social and cultural geographies of families affected by rare disease. Social & Cultural Geography. 2024; 1–23. https://doi.org/10.1080/14649365.2024.2416672 (postcard 3f)

- **Complex notions around choice**: several participants portrayed their sense of doors closing behind them ("no other door, not even a room"[61]), associated both with loss of what had been hoped for and expected, and with an acceptance of the need to grasp the new situation in which they found themselves.

> That door is not mine
> That boy is not mine
> I wish they were [62]

> And hope to look back one day and say,
> that was two lives worth living. [63]

In contrast, one explored the difficulties of making a choice that others could not understand:

> this anomaly I insisted on carrying to term [64]

- Frustration at how **choices open to children with complex disabilities are constrained by the world around them** as much, or more, than by the nature of their genetic condition, and the further invisible labour required by parents to challenge exclusion ("The planning and thought process, the time that goes into organising inclusion is absolutely exhausting …"[65]):

> Who are these planners these architects / these policy makers / who create the world in inaccessible ways? [66]

> The park planners
> forgot to include me [67]

61. Strange new world, Helix p18
62. Silhouette, Helix p63
63. Two lives, Helix p65
64. 41 weeks, Helix p17
65. Gorman R, Farsides B. Mail art methods and the social and cultural geographies of families affected by rare disease. Social & Cultural Geography. 2024; 1–23. https://doi.org/10.1080/14649365.2024.2416672 (postcard 1f)
66. Remember us? Helix, p44
67. A fun place to be? Helix p45

More subtly than physical inaccessibility, attempts by others to achieve 'inclusion' may be experienced as **erasing or 'explaining away' the impacts of disability,** as in this postcard:

> Dear Headteacher
> Please refrain from describing a lack of ability to communicate need as a lack of confidence... No one sees two neurologists, each twice yearly, about their confidence. [68]

It is worth noting that direct references to genetics or genomics were rare in these creative outputs and associated discussions, although the incursion of the clinical world on everyday life was a repeated theme. The findings from this part of the project suggest the need to increase awareness among health professionals of the day-to-day importance of so many other aspects of their patients' social worlds, thereby equipping them with a sense of "what to listen for" in their interactions with families. [69] While recognising that the insights shared are illustrative and not representative, [70] it is also crucial to be alert to the way in which wider social attitudes (for example assumptions with reference to the value of a life with disability) can in turn influence the way that genomic services are provided, as spelled out by one participant:

> When our first child was born, we didn't have a diagnosis. They were like, we can talk to you about the chances of what would happen if you had another child... they're obsessed with that... the whole ethos is that, it is a bad thing, but we love our daughter for who she is and we don't want her designed out of existence, so, when you're saying "oh the risk of this happening again", you're being very negative about a member of our family whom we love the way she is. [71]

68. & Gorman R, Farsides B. Mail art methods and the social and cultural geographies of families affected by rare disease. Social Cultural Geography. 2024; 1–23. https://doi.org/10.1080/14649365.2024.2416672 (postcard 1g)
69. Gorman R, Farsides B. Writing the worlds of genomic medicine: experiences of using participatory-writing to understand life with rare conditions. Medical Humanities. 2022;48:e4. https://doi.org/10.1136/medhum-2021-012346; Gorman R, Farsides B, Gammidge T. Stop-motion storytelling: Exploring methods for animating the worlds of rare genetic disease. Qualitative Research. 2023;23(6):1737-1758. https://doi.org/10.1177/14687941221110168
70. One parent, for example, emphasised in private correspondence that unlike others she didn't mind being referred to as 'mum': she saw it as a badge of authority and recognition of her knowledge of her child.
71. Gorman R, Farsides B, Bonner M. Crafting representations of rare disease: collage as qualitative inquiry. Arts & Health. 2023. https://doi.org/10.1080/17533015.2023.2254328

Parents' reflection on the outcomes of the research

A number of the parents involved in one or more of these creative activities joined a meeting in February 2024 to explore their experiences of being involved in the research and their hopes for what might happen as a result of EPPiGen's findings. Themes from the research that were reiterated and reinforced at the meeting included:

- the importance of being able to share a rounded picture of their child's lived experience with professionals, reinforcing the humanity and moral agency of patients and families;
- recognition of parents as key members of the 'team' caring for and supporting their child – accompanied by acknowledgment of the need for more support themselves in navigating disjointed and complex services, and recognition of how distressing encounters with individual professionals or the inflexibility of the 'system' itself can be a source of long-lasting trauma; and
- the need for better co-ordinated systems – extending beyond the healthcare system to include other welfare services needed by their child.

There was strong enthusiasm for the many different creative outputs developed through EPPiGen to be widely disseminated to diverse audiences: across the healthcare sector, for example supporting health professional education; to other families in similar situations, validating their experiences and showing that they are not alone; and through art exhibitions open to the general public to help break down negative attitudes to disability (see Appendix 3 for a map of the extensive distribution of the Helix poems, and other details of dissemination). The parents involved in the project have played an active role not only in the ongoing dissemination of the work they co-produced but also in proactively continuing to contribute their knowledge and experience to genomic medicine and policy independent of EPPiGen (see for example the poem in Box 2 below, subsequently written and published by an EPPiGen collaborator[72]).

Parents also highlighted the benefits they had personally obtained from participating in the project, emphasising the need to create "important spaces" where other parents, patients and carers could have the opportunity to share their experiences and knowledge in ways that are creative, constructive and therapeutic. The transformative impact of support from other families with similar lived experience was also noted as illustrating the potential benefit of a genetic diagnosis even when unaccompanied by active treatment options, enabling families to connect with others facing similar challenges and gain access to mutual support and knowledge that would otherwise have been unavailable to them.

Parents were keen for future research to be able to learn from these positive experiences, and highlighted in particular the importance of raising awareness among members of research ethics committees of how participants actively value the opportunity to take part in such activities, when conducted in ways that promote an ethos of mutual support, compassion and understanding. Finally, they emphasised the importance of ensuring that perspectives from patients and families with diverse backgrounds informed the development of genomic services.

72. Davey A. Proband. Consilience. 2024: 17. https://www.consilience-journal.com/issue-17-proband, published in response to a paper on the genomic diagnosis of rare paediatric diseases in the New England Journal of Medicine

Box 2 Proband: Alex Davey | Content warning: child loss

Pediatric disorders include a range of highly penetrant, genetically heterogeneous conditions amenable to genomewide diagnostic approaches

[Pediatric. adj. relating to the branch of medicine dealing with children and their diseases]

We had a child

A total of 13,449 probands were included in the analyses
[Proband. n. (genetics): person serving as the starting point for the genetic study of a family]

His name was Benjamin.

Exome sequencing and microarray data ... were complemented by rich clinical phenotypes

[Phenotype. n. (biology): the set of observable characteristics of an individual resulting from the interaction of its genotype with the environment]

Soft curling hair, Mum's eyes, Dad's nose, velvet cheeks, chubby feet, huge lopsided smile

Eligibility criteria included ... neurodevelopmental disorders, congenital anomalies, abnormal growth measurements, dysmorphic features, unusual behavioral phenotypes, and genetic disorders that have large effects but for which the molecular basis was unknown.

[Disorder. n. (medicine): a disturbance of normal functioning of the mind or body]

Smiling at fairy lights, batting at baubles, following bubbles, reaching for cuddles

Probands were classified as having received a diagnosis if one or more variants or two or more compound heterozygous variants were annotated as pathogenic or likely pathogenic by either the proband's referring clinician or according to the predicted classification and if the contribution to the phenotype was not clinically annotated as "none."

[Variant. n. (genetics): An alteration from the most common DNA nucleotide sequence]

He played Joseph in the Nativity, baked cookies for his sisters, went canoeing on a beanbag, enjoyed a good disco, promised his Beaver promise. He saw how leaves filter the sunlight and listened to the rhythm of the rain.
He loved unconditionally. He taught me to dream

Factors that considerably increased the chance of receiving a diagnosis included: the presence of severe intellectual disability or developmental delay, longer time interval since recruitment, being the only affected family member...

All members of the family were affected

Through its genomic analysis of a large clinical cohort *(each with gifts and talents, needs and desires, friends and families, hopes and ambitions)* this study shows how the fusion of clinical expertise, genomic science, and bioinformatics *(tolerant patients and trusting parents)* can drive diagnosis and discovery in families in which standard, phenotypically driven diagnostic approaches have failed.

In which love, learning and tenacity have triumphed

We thank the patients and families involved in the study.

His name was Benjamin.

3.2 Patients' and families' experiences of genomic medicine

Other EPPiGen studies focused explicitly on patients' and families' experiences of genomic testing. Participants were either recruited because of their involvement in a large-scale study such as the 100,000 Genomes Project or Deciphering Development Disorders, or because they had accessed the NHS Genomic Medicine Service. Collectively, this complex and multifaceted work has highlighted a stark contrast between participants' lived experiences and the uncomplicated representations of genomic medicine often depicted in policy and the media.[73] Many spoke of long, arduous, and potentially endless journeys, for which they had been largely unprepared.

This section focuses on four key findings of short and long-term policy and practice relevance. The broader study encompasses rich datasets illuminating the wider impact of genomic medicine on the lives of individuals and families.

3.2.1 Who is the patient in genomic medicine?

Genomic medicine challenges the idea of patient experience as an individual journey, with different family members involved in and affected by the process and outcomes. It was common for participants to describe their experiences of genomic testing as a collective endeavour; a shared journey albeit experienced from different perspectives.[74] This was not just apparent in the way that parents, who were tested to help make sense of a genetic finding in their child, discussed their experiences but was also evident for others, who spoke of the salience of the journey for a range of people including those genetically unconnected, those 'at risk' or 'healthy carriers'.[75] These 'linked lives' were at the forefront of participant's minds with respect to ethical and moral decision-making, as well as providing care and support.

Maggie and William's "story of us" (Box 3) is illustrative of the more collective, and often inter-generational, ways in which participants discussed what it means to be a patient in this context. For many, this was more than shared decision-making. Partners, stepfamilies and other biologically unrelated kin felt an inherent part of the journey, experiencing it alongside and with others.

As genomic testing becomes embedded in routine healthcare in the UK, it is vital to think about the potential implications for those beyond the individual patient. EPPiGen research reinforces the idea that genetic professionals are family practitioners, and as genomic medicine reaches all areas of medical practice, this raises important questions about how a more collective or familial approach might be accepted and/or incorporated.

73. Lyle K, Weller S, Lucassen A. Journeys through genomics: co-producing visual resources to communicate patient experiences. Sociological Research Online. 2024; 0(0). https://doi.org/10.1177/13607804241252528.
74. Weller S, Lyle K, Lucassen A. Re-imagining 'the patient': Linked lives and lessons from genomic medicine. Soc Sci Med. 2022 Mar;297:114806. https://doi.org/10.1016/j.socscimed.2022.114806.
75. Horton R, Crawford G, Freeman L, Fenwick A, Lucassen A. Direct-to-consumer genetic testing with third party interpretation: beware of spurious results. Emerg Top Life Sci 27 November 2019; 3(6):669–674. https://doi.org/10.1042/ETLS20190059.

BOX 3

Maggie and William

William was diagnosed with a neurological condition about 15 years ago, and it was suspected that his father also had the same condition. William's genome was sequenced to explore a genetic cause. So far, he has received a letter stating that nothing has been found. He is living with a probable diagnosis of a rare inherited neurological condition which could have implications for their adult children.

A genetic result would make little difference to William in terms of the management of his condition, but they both felt greater certainty over heritable risks would enable their son and daughter to make informed life course decisions about family formation:

> "Andrew is 30 now and we know he's thinking about settling down so it just makes you very mindful that we just haven't got the information that really we can share with them."
> (Maggie, interview 2)

In many respects, William is the patient and much of his discussion focused on coming to terms with the condition, the onset and progression of symptoms and his pragmatic approach to adapting to physical changes. For Maggie, her own genetic information played no part in the process, and she would not conventionally be recognised as a patient. But how she described their experiences and how she positions herself within the process suggested otherwise.

Encounters with health professionals, moral deliberations about the testing of their children, and anxieties about potential outcomes were similarly felt and shared. Across all the interviews, everything was described in terms of 'we' or 'us' – from being a patient, to making challenging decisions and to facing outcomes or uncertainties.

> "... there are masses of implications [of mainstreaming genomic medicine] obviously for people, patients as we would be, and we were quite clear that we signed up."
> (Maggie, interview 2)

> "Personally, I would find it easier if we had something concrete because I think then we would know in our heads really what we are facing."
> (Maggie, interview 3)

Their "story of us" and their shared sense of their journey through genomic testing as a couple was marked. This was something happening to, and about them as a couple, but also as parents and potential grandparents. Their example emphasises how lived experiences of patienthood can be shared and shaped by a collective sense of moral responsibility to others.

3.2.2 The promise and reality of genomic medicine

As technological advances have made genetic testing increasingly affordable and accessible, genomic medicine become a central component of political ambitions for the NHS. Such optimistic narratives about genomic medicine's transformative potential significantly influence how patients and their families approach and experience genetic testing and treatment.

EPPiGen's research with patients highlights three key roles they envisage for genomic data: shaping relatives' futures, making sense of the past, and advancing scientific knowledge for the benefit of humanity. Box 4 illustrates these roles through patient experiences.

While patients mobilise genomics differently in their aspirations, all rely on obtaining clear, definitive genetic information to enable better futures. This aligns with policy narratives but contrasts with current genomic capabilities. Though we can now sequence genomes efficiently, interpretation remains a significant challenge. EPPiGen participants' experiences highlight this disconnect: none have received significant findings from genome sequencing – not because genetic factors are ruled out, but because analysis remains ongoing and uncertain. Realising their envisioned futures requires advances in genomic interpretation, making these journeys potentially long and open-ended.

As genomic medicine expands, it is imperative that its promised potential is balanced against these uncertainties to better prepare both patients and health professionals for the challenges ahead.

BOX 4

Envisaged roles for genomic data

Shaping relatives' futures

As genomic journeys are often collective, many individuals pursue genetic testing primarily for their relatives' benefit rather than their own. William's story demonstrates this family-centered motivation.

William was initially reluctant to explore genetic testing. As his wife Maggie explains:

> "You [William] only ever wanted to have yourself investigated because I pushed for it because we've got children. I think your preference at the time, early on, was that actually, 'No, if I've got what my dad had I'll just run with it, see how it works, I'd rather not know much info'."

For William, understanding the genetic mechanisms behind his condition held little personal significance – he had already accepted its hereditary nature through the connection to his father's illness. Rather, William and Maggie's pursuit of genetic testing centered on their children's futures and how this information could inform their life choices, as Maggie explained:

> "the urgency of [finding a genetic cause] perhaps is the thing that has changed for me as the children have got nearer childbearing age and are thinking about children and, you know, planning ahead with their lives."

Making sense of past

The value of genetic information is not always about its future implications but can also be about making sense of the past. Claire's story illustrates this.

Diagnosed with bowel cancer in her early forties – unusually young and with no family history of the disease – Claire struggled to understand her diagnosis given her healthy lifestyle. As she explains:

> "I've lived a fit, healthy life. I've never smoked, I don't drink, and I never came from a family that smoked or drank either, so we had really healthy lives, and you just think 'I've done everything right, where does this come from?' and then that spurs you on. So, I would say that, I wanted to know everything about it. I wanted to know if there was something that I could have done, or if it was genetic then... it's just rotten luck. So, to find out more information was a priority to me at the time."

For Claire, understanding the genetic basis of her cancer wasn't about future planning, but about making sense of her situation – a genetic explanation would help her attribute her diagnosis to her genetic makeup rather than questioning her past choices.

Beyond personal insights, patients often view their genetic data as contributing to broader scientific advancement. Shirley's story illustrates this altruistic motivation:

Shirley is in her 60s and comes from a large family. There is a long history of cancer in her family, and she was diagnosed with breast cancer herself several years ago. While she and her relatives underwent genome sequencing, her motivation was not about understanding her family's cancer history – which she discusses with frank acceptance – but rather about advancing cancer research. As she explains:

> "I think it's quite important [to find a genetic cause] because if people don't look... how can they find a cure? How can they find what it is, or to beat it?"

For Shirley, participating in genomic research offers a way to contribute to the broader fight against cancer, helping to create better outcomes for future patients.

3.2.3 Beyond the diagnostic odyssey: What next for patients and families?

Participants' journeys were often lengthy and characterised by multiple investigations and encounters with a range of specialisms over many years. Whilst participation in genomic testing can offer the possibility of personalised treatments or access to support, EPPiGen research highlights that, for many, a diagnosis or label was often not the end of the journey. Rather, any outcomes represented but a juncture or turning point that did not necessarily provide the clarity or reassurance they had originally hoped for. A diagnosis of a rare disease, for example, often meant very little in terms of understanding what the future might hold both for an individual and the wider family and could raise more questions than it answered (Box 5).

BOX 5

"...even with a diagnosis, it doesn't change our outcomes particularly, it's just, we know it's this gene, but beyond that, you know, we don't know much more, we're not going to change anything we're doing, we're not, you know, you have your answer, but actually, your answer... I think in some instances, with some other families, maybe it changes the medicines that you're on or changes your diagnosis, or it changes the expectation you can have for that person's life and development, but I think in our instance, it's not, you know, it's just a string of letters and there's not many of them around." (Aliza)

What the future holds is also determined by the economic, social and cultural capital to which participants have access, in terms of understanding or managing the news, or further uncertainty or supporting the family's care needs. For example, those with personal/familial connections to medical professionals spoke of being able to access alternative sources of information, whilst those with financial resources were more able to afford expensive equipment. Across the board, a lack of support for the mental health of all those affected by the process and outcomes of genomic testing was discussed.

Our work points to the propensity for many supporting/living with rare or undiagnosed genetic conditions to 'fall between the gaps' in social care provision. Even with a diagnosis, some struggled to access necessary resources and support (Box 6). This work is especially timely given the widespread care crisis, which is likely to continue to exacerbate the situation for many.

BOX 6

"... [a diagnosis of a rare condition] just means everyone can go, "Ooh, no, that's not us. I don't know anything about that" (Sophie)

"...she's on like 18 different med [ication] s now and we've got suction machines and nebulisers and sats probes and we reposition her and check her multiple times a night and it's really full-on. Like I love it, I'm exhausted, really could do with a bit of support. Social Services discharged us... Nobody argues with how serious [this] Syndrome is. ...I've been re-referred to Social Services, I've chased twice, I've heard nothing." (Sophie)

A diagnosis could, however, open up opportunities to access specialised support groups. Participants spoke of charitable organisations that provided vital resources, particularly during the often-lengthy waits between visits to specialists. Social media platforms were described as a vital 'lifeline', enabling patients and families to share their experiences and learn from others (Box 7). For those living with/supporting those with a rare condition, and where a paucity of information about the realities of day-to-day life is commonplace, this was especially significant.

BOX 7

> "And in that period of time where we'd had the diagnosis but hadn't seen the specialists, they [Facebook group] were really helpful and they have letters and stuff to give to the hospitals and like protocol to follow, and other parents were like telling me what to do. So, I leant on them a lot. There's [another] Facebook group... So, I started just by going, posting videos of what <daughter> was doing and going, "What the hell's going on here, guys? The doctors don't seem to know. Is this common? Do your kids do this?" (Hayley)"

Our research highlights the need to ensure that, in the quest for more rapid diagnoses, the care needs of individuals and families are also attended to effectively. This includes helping individuals and families to prepare for the range and fluid nature of any potential outcomes, as well as ensuring they also have access to appropriate social care and welfare support.

3.2.4 Ethical issues arising from the immortality of genomic data

Unlike the results of many other medical investigations that are linked to the time of sample collection, germline genomic testing provides immortal data that do not change across time and may have relevance for relatives and generations far beyond the patient's own lifespan.[76] When asked about their experiences of having a genomic test, many focused on the physical process of giving a sample as it was more tangible than the subsequent delivery of genomic data from that sample. The test was often described as simple compared to other more invasive medical procedures (Box 8). This focus on the simplicity of the test provided a distraction from the immortality of the data generated, yet could result in participants being blindsided by unexpected findings.

BOX 8

> "You know, simple blood tests at the hospital. (Claire)"

> "I was OK with it. It's only a blood test. I didn't have a problem with it. I wouldn't hesitate to do it again. You know, just go. It's not as though it's an invasive test (Richard)"

76. Lyle K, Weller S, Horton R et al. Immortal data: a qualitative exploration of patients' understandings of genomic data. Eur J Hum Genet. 2023;31:681–686. https://doi.org/10.1038/s41431-023-01325-9

A sense of the immortality of genomic data was, however, expressed through a focus on heritability, with many prioritising the potential benefits for relatives rather than themselves. Participants spoke of the potential value for children, grandchildren or future generations in terms of identifying risks before symptoms manifest, or with respect to informing reproductive decisions (Box 9). Not all participants, however, fully grasped the implications for others and/or struggled to communicate them to family members.

Box 9

> So, I think the same for [older daughter] if she is a carrier of something, that is already true and us being able to give her more information and more support and more preparation and more signposting can only be helpful. (Sophie)

> ...the benefit of the genetic study is that it would make it easier to identify people that have got the gene but haven't got symptoms. (Clive)

> [sister] knows I've had [cancer], but I haven't told her about this [genome test] I didn't think it was important. (Betty)

The immortality of genomic data featured, both implicitly and explicitly, in participants' accounts of the value of genomic data as a collective resource. Some expressed altruistic motivations, seeing their data as benefiting future generations or contributing to broader medical research and scientific discoveries. This collective perspective reinforces the need for transparent policies around data sharing and use. It also highlights the importance of framing genomic data as a legacy that extends beyond individual diagnoses (Box 10).

BOX 10

> "...not only did it help [my son], but I just felt it could help other people and young peoplein the future." (Carol)

> "...if by looking at his blood or his saliva or his whatever, you know, helps them to make new discoveries and come up with new things, I think that is really important, for him [son] and for families in a similar situation in 10 years' time... (Monique)

> "...at the time having been given this news [cancer diagnosis] that it looked really aggressive I was thinking I might not be around, so yes I was just hoping my sample would be there and I would leave some sort of legacy. (Lynn)

Our research has shown that understandings of the immortality of genomic data may bring feelings of genetic responsibility to past, present, and future generations. These understandings must take a more prominent position in patient and health professional interactions. The immortality of genomic data raises new ethical challenges for health professionals, patients and families alike, such as ensuring consent for possible future interpretations; determining when genomic data are best sought (at birth, on illness etc) and reinterpreted; and balancing the confidentiality of patients and duties of care towards others.

This research demonstrates the need for better public dialogue about the reality of genomic medicine and what we can realistically expect from it. To help address this, EPPiGen implemented a range of engagement initiatives, including the development of open resources to support patients and healthcare professionals;[77] the 'Songs for Genomics' collaboration which translated EPPiGen research findings into song, and the creation of hands-on family-oriented activities at science festivals (see Appendix 3 for further details and examples).

77. Lyle K, Weller S, Lucassen A. Journeys through genomics: co-producing visual resources to communicate patient experiences. Sociological Research Online. 2024; 0(0). https://doi.org/10.1177/13607804241252528.

4

PERSPECTIVES OF HEALTH PROFESSIONALS

As genomic medicine expands, health professionals face significant changes in their clinical practice, requiring new approaches and competencies and raising new ethical and social challenges. EPPiGen investigated these challenges across different groups of health professionals, examining how various parts of the workforce experience and navigate these changes. In this section of our report, we present the findings of this research with a focus on identifying the support and resources needed to help health professionals feel confident and prepared to address the ethical dimensions of genomic medicine in their practice.

4.1 Health professionals working in clinical genetics

Qualitative research with **health professionals working in clinical genetics**, highlighted the many ethical challenges that are a routine part of clinical practice for professionals working in this field. Issues highlighted by participants included:

- interpreting the significance of identified genetic variants including 'incidental' findings;
- determining how and with whom to share information;
- supporting decisions about reproduction;
- considering the consequences of genetic testing in childhood; and
- managing resource constraints and limitations on access to services or tests.[78]

The research highlighted how, despite many competing practical demands on their time, health professionals interviewed engaged deeply with ethical decision-making and found it both challenging and at times personally distressing.

Key factors in enabling professionals to engage with these often finely-balanced decisions were identified as the existence of a shared working culture in which the value of undertaking the "moral and ethical work" required to engage with these issues was recognised, accompanied by the support provided by a 'community of practice' of similarly minded colleagues. In particular, participants emphasised the importance of a safe space to explore the ethical tensions experienced in clinical practice with colleagues who were willing and able to offer their own insights and knowledge, participate in discussion, and provide validation and reassurance. One important forum offering such a safe space is the Genethics Forum, an informal community of practice for genetics professionals around the UK, offering informal in-person meetings 3 times a year where participants talk about issues arising in their own practice (see Box 11 below). [79]

78. Carley H. How can we foster situated ethical decision-making in clinical genetic practice? 2023. MSc in Clinical Genomics 2022-2023.
79. Sahan K, Lyle K, Carley H, et al. Ethical preparedness in genomic medicine: how NHS clinical scientists navigate ethical issues. Journal of Medical Ethics. Published Online First: 06 February 2024. https://doi.org/10.1136/jme-2023-109692. See also http://genethicsforum.ning.com/

BOX 11

Since 2001, the UK Genethics Forum has been a national case-based forum for discussion of ethical and legal issues arising in genetic / genomic medicine. The primary goal of the Forum is to support genomics professionals in 'ensuring that ethical considerations inform the day-to-day practice of their units' and promote the sharing of experience and good practice in addressing ethical questions.

In addition to its primary case-based function, Genethics has also played an important role in informing policy development. It is frequently judged a reliable source of advice and support, facilitating in-depth discussions regarding ethical and legal issues within cases that arise in clinical genomic practice. Health professionals are encouraged to present ethically challenging cases they would like help with, which are examined within the group, and the ethical dimensions of various management approaches are explored and discussed.

As genomic medicine becomes 'mainstreamed' within the NHS, **health professionals who are not genetics specialists** will increasingly be expected to engage with the complex information generated by WGS, and to be able to support their patients appropriately. The challenges that such mainstreaming will bring with it were highlighted by participants in the qualitative study. One, for example, commented that while non-specialists might occasionally attend Genethics Forum meetings, they currently "exist on the periphery" of the Genethics and wider genetics community of practice.[80] It was noted that very little is known at present about how non-specialist health professionals engage with ethical decision-making about genetics, or what resources they might be able to draw on to support them.

4.2 General practitioners

GPs, who have always provided the first port of call for patients in the NHS, are increasingly likely to be expected by their patients to engage with genomic medicine. However, research with GPs on the English South Coast, conducted as part of EPPiGen, illustrated a significant gap between the positive and optimistic statements of policymakers discussed earlier (see section 2) and the attitudes and experiences of GPs.[81] GP participants saw public policy statements about the promise of the "genomic dream" as utopian, and were concerned that aspirations of genomic medicine to support people to live longer healthier lives failed to take account of the present-day needs of people already living with serious ill-health and facing considerable challenges. In line with this concern, they suggested that support for people with dementia and improvements in the provision of social care were of much higher priority in the immediate term. More broadly, they also expressed a degree of anxiety about the medicalisation of day-to-day life implicit in the emphasis on genomic screening. More testing and more labelling were perceived to add to patient anxiety without necessarily enabling preventative action – and could also add to existing workforce pressures.

80. Carley H. How can we foster situated ethical decision-making in clinical genetic practice? 2023. MSc in Clinical Genomics 2022-2023

81. Mwale S, Farsides B. Imagining genomic medicine futures in primary care: General practitioners' views on mainstreaming genomics in the National Health Service. Sociol Health Illn. 2021 Nov;43(9):2121-2140. https://doi.org/10.1111/1467-9566.13384

4.3 Clinical scientists

Our research investigated ethical issues arising in laboratory practice within genomic medicine, an area that has received limited attention. Through analysis of Genethics Forum cases and in-depth interviews with laboratory scientists, we examined how ethical challenges manifest in their work. Our findings highlight the important, yet often overlooked, role of clinical scientists in caring for patients through their handling of genomic data, which acts as a proxy for the patient. Their caring practices are particularly evident through their roles in constructing and acting as temporary custodians of information. Through this role, clinical scientists encounter ethical challenges in three key areas (see Box 12):

- Determining what counts as clinical information;
- Safeguarding the movement of information;
- Navigating regulations in caring for patients.

As genomic medicine expands beyond specialist settings, recognising and supporting clinical scientists' vital role in patient care becomes increasingly critical. Understanding these ethical challenges can help ensure clinical scientists receive the preparation and resources they need to navigate complex decisions about genetic information in expanding genomic services.

BOX 12 Sources of ethical challenges for clinical scientists

1. **Determining what counts as clinical information**

Genetic testing, particularly WGS, generates extensive data, but transforming this data into meaningful information requires complex and often subjective interpretation. This complexity is particularly evident in variant re-interpretation, where changes in variant classification can significantly impact clinical care and family decision-making. For example, when variants are downgraded from pathogenic to uncertain significance, or when previously reported variants no longer meet reporting criteria, clinical scientists must carefully navigate both technical and ethical considerations. Constructing relevant information out of this complex data is an important part of how clinical scientists care for patients. Although patients are not physically present in the lab, they are visible through the data, information, and reports that are acting as proxy patient, and clinical scientists are mindful of the actions that might be taken by others on the basis of the value that they place on certain information.

2. **Safeguarding the movement of information**

Clinical scientists serve as temporary custodians of genetic data and information, carrying responsibility for determining appropriate use and access. They face complex challenges in deciding when specific information should enter clinical settings, from assessing the appropriateness of testing requests to managing clinically significant incidental findings when requesting clinicians may be reluctant to discuss them. Managing the flow of genetic information presents additional challenges. Clinical scientists reported including information in reports that, while not immediately clinically relevant, may become important for future care. They also carefully considered how to present information so it remains clearly understood as it circulates among health professionals and patients. Tending to and safeguarding the movement of information in this way is an important, yet unseen part of patient care. As genetic testing expands beyond specialist settings, these challenges in managing information flow and ensuring appropriate understanding across different healthcare contexts become increasingly significant.

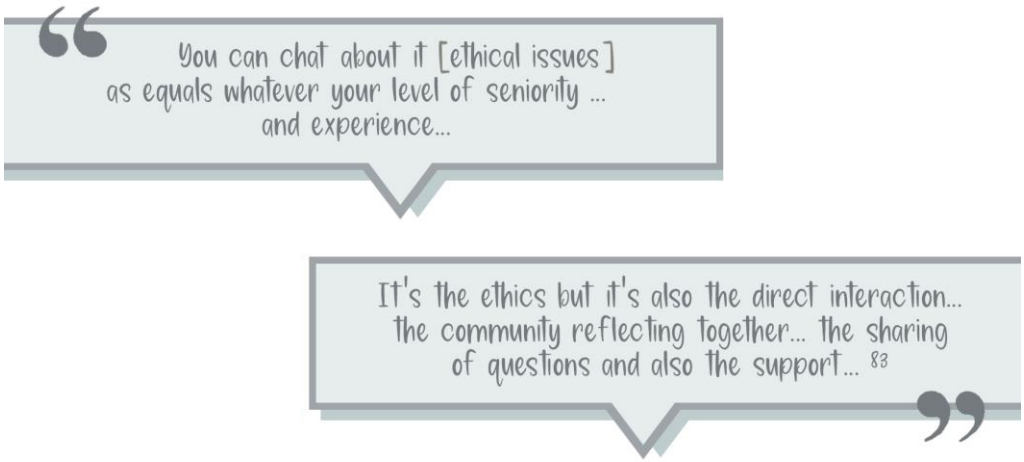
3. **Navigating regulations and organisational structures in caring for patients**

Clinical scientists' caring practices for patients are often obstructed by overinterpretation of regulatory and bureaucratic procedures, particularly around data access. For instance, genetics services often withheld reports to other centres who needed it for relatives' predictive testing due to lack of written consent for sharing. The increasingly blurred boundaries between research and clinical practice create additional challenges in navigating regulatory systems. This was illustrated in a case where data about a familial cancer susceptibility variant existed from a patient's research-based whole genome sequencing for intellectual disability. This raised complex questions about whether such data should influence predictive testing decisions and whether laboratory and clinical staff had obligations to locate and use these research results.

4.4 Support for health professionals

The need for support for professionals (whether specialising in genomic medicine or in other areas of healthcare) in handling ethical challenges inherent in genomic medicine, and in appropriately supporting their patients, was identified as a common theme in the work carried out by the EPPiGen teams. As touched on above, one important form of support is the Genethics Forum – an informal community of practice where any health professional working in genetics can share ethical difficulties for feedback and support from their peers (see Box 11).[82]

The value attached to access to such a forum emerged clearly in the qualitative study with clinical genetics professionals, who highlighted in particular not only the knowledge and experience that was shared by forum attendees, but also the non-hierarchical nature of the discussion, and the recognition of the importance of context in exploring the best approach in any given situation. Comments included:



As part of the qualitative study with clinical genetics professionals, EPPiGen also explored the scope to build on the support offered by the Genethics Forum by developing an online resource: an organised knowledge base drawn from past Genethics Forum discussions that could be used to promote learning and reflection, thereby supporting both individual decision-making and locally-based team discussions.[84] Given the contextual nature of many ethically challenging decisions, it was reiterated that such a resource should support the *process* of thinking through the ethical implications of different courses of action, rather than simply being seen as a source of solutions.

In addition to support in thinking through ethically-fraught decisions, health professionals also need practical tools to help them in the day-to-day, but always context-dependent, aspects of their work such as supporting patients in communicating genetic results with family members. To date, there is relatively little research (at least published in English) on how health professionals can best support people to share genomic results, although the limited number of interventions reported (involving, for example, telephone counselling or resource materials) were appreciated both by patients and health professionals.[85] EPPiGen's review of these interventions highlighted the importance of involving patients in developing future interventions; identifying the right people to share information with (including through the use of digital interventions such as myKinMatters), and avoiding overburdening people who do not need to know; and drawing on behaviour change theories and models to maximise effectiveness.

82. Quotation in Box 1 on Genethics Forum taken from Sahan K, Lyle K, Carley H, et al. Ethical preparedness in genomic medicine: how NHS clinical scientists navigate ethical issues. Journal of Medical Ethics. Published Online First: 06 February 2024. https://doi.org/10.1136/jme-2023-109692
83. Carley H. How can we foster situated ethical decision-making in clinical genetic practice? 2023. MSc in Clinical Genomics 2022-2023
84. Ibid
85. Ballard LM, Band R, Lucassen AM. Interventions to support patients with sharing genetic test results with at-risk relatives: a synthesis without meta-analysis (SWiM). Eur J Hum Genet. 2023;31:988–1002. https://doi.org/10.1038/s41431-023-01400-1

5.1 Elements of ethical preparedness

Drawing on all these different strands of research, EPPiGen collaborators argue that being ethically prepared cannot just be about establishing systems and processes such as setting up committees or devising frameworks, although these may be valuable contributors or routes to ethical preparedness. Rather it is concerned with **identifying and revealing issues that are of ethical concern** to patients and their families, to the health professionals involved in providing care, to researchers, and to policymakers, so that all concerned may be better placed to handle them.[86] Being ethically prepared, whether as a practitioner, researcher, manager or policy-maker, can be described in terms of **behaviours**, whether of individuals or organisations: that is, as "the state of being prepared to consider ethical issues in everyday practice as they arise in particular contexts".[87]

It is therefore crucial to consider **how such behaviours can be supported**. Being ethically prepared as an institution or as a policy-maker involves "establishing settings that make it more likely for a person, group or organisation to adopt ethical decision-making behaviour".[88] Drawing on the COM-B model of behaviour change, which focuses on the roles of capacity, opportunity and motivation in influencing behaviours, factors that are likely to help include:

- Ethical capacity: ensuring that decision-makers and practitioners have **access to relevant ethical expertise**, appropriately informed by an understanding of the real-life challenges arising for those working on the ground.
- **Decision-making structures that allow for and encourage ethical input**, by offering opportunities for those making decisions to access and draw on ethical expertise, in a timely way.
- **Institutional cultures that value ongoing ethical deliberation** as intrinsic to their work, rather than as a 'nice-to-have' add-on or 'check' to be completed: such cultures constitute a necessary part of the motivation for ethics to inform the whole way that genomic medicine/research is practised.

Crucially, being ethically prepared does not mean having all the answers: as illustrated throughout this summary of EPPiGen's research, 'answers' will often depend on context and will rarely be straightforward. We suggest that an essential element of being ethically prepared includes the ongoing provision of **spaces and opportunities for practitioners and others to explore these ethical concerns or obstacles** and find ways of responding to or resolving them. In particular, this is always going to involve more than legal or procedural compliance or, in the context of research, meeting the requirements of ethical review.[89] Consistent guidance is helpful, but not sufficient. [90]

86. Farsides B, Lucassen AM. Ethical preparedness and developments in genomic healthcare. Journal of Medical Ethics. Published Online First: 02 June 2023. https://doi.org/10.1136/jme-2022-108528
87. Lyle K, Weller S, Samuel G, et al. Beyond regulatory approaches to ethics: making space for ethical preparedness in healthcare research. Journal of Medical Ethics. 2023;49:352-356. https://doi.org/10.1136/medethics-2021-108102
88. Samuel G, Ballard LM, Carley H et al. Ethical preparedness in health research and care: the role of behavioural approaches. BMC Med Ethics. 2022;23:115. https://doi.org/10.1186/s12910-022-00853-1
89. Lyle K, Weller S, Samuel G, et al. Beyond regulatory approaches to ethics: making space for ethical preparedness in healthcare research. Journal of Medical Ethics. 2023;49:352-356. https://doi.org/10.1136/medethics-2021-108102
90. Sahan K, Lyle K. Practising genomics ethically – is more guidance really the answer? Journal of Medical Ethics Forum. 4 March 2024.

The Genethics Forum provides an important example of such a space for genetic specialists; similar opportunities need to be created for health professionals who are not genetic specialists; for researchers; and for patients and their families who similarly value and benefit from opportunities to share knowledge and draw comfort from the experiences of others in a similar situation. It is also important to recognise that such opportunities may already exist for some or all of these stakeholders (for example in the form of many patient support groups, often started by families for mutual support): what is required may not be new initiatives or institutions but better support, both in terms of finances and ethical expertise, for those already playing this valuable role.

> We argue that researchers need spaces and opportunities in which to foster a person–orientated ethics approach more readily. We describe this as 'ethical preparedness', and suggest it requires action across the whole research community – including regulators, ethics committees, funders and publishers of academic research, as well as researchers themselves... [91]

Responsibilities arise at different levels to promote and support ethical preparedness. Health professionals and researchers have responsibilities for their own practice and behaviours. The organisations where they work have responsibilities to support their staff in meeting those responsibilities and ensure they have the tools (in particular the time) to do so. Those who set the policy agenda 'at the top' have responsibilities both with respect to the culture they set (including the public promises made) and in providing the necessary resources. They also have a responsibility to ensure that there is a place for critical scrutiny at the highest level: remaining open, for example, to the question of whether the approach to genomic medicine services is still the right one; [92] and being alert to the need to recognise and manage the opportunity costs of mainstreaming WGS. [93] **There is a real risk of 'moral distress'** if action (or inaction) at one level impedes responsibilities at another: for example where practitioners simply do not have the time, or access to the necessary support, to respond appropriate to their patients' needs. Lack of such resources can be as ethically challenging for health professionals as the more obviously ethically-fraught dilemmas that arise inherently in genomic medicine.

The responsibilities associated with ethical preparedness are also **continuing and dynamic**: they cannot simply be discharged by a one-off action – for example by undertaking ethical review or by establishing a standing ethical advisory committee. Establishing appropriate systems can be a necessary part of ethical preparedness, but the responsibility extends to the ongoing way in which they exercise their functions, and in which their advice flows through into policy and practice.

Finally, being ethically prepared requires an **inclusive approach**. It involves recognising the importance of listening to people who are doubtful about the value of WGS or the priority to be given to it as well as to the voices of keen trailblazers. By "inhabiting the space between enthusiasts and pessimists about genomics" [94] ethically-prepared decision-makers will maximise their chances of developing and offering genomic medicine services in ways that are sensitive to ethical challenges and meet the needs of the patients and families who draw on them.

91. Lyle K, Weller S, Samuel G, et al. Beyond regulatory approaches to ethics: making space for ethical preparedness in healthcare research. Journal of Medical Ethics. 2023;49:352-356. https://doi.org/10.1136/medethics-2021-108102
92. Samuel GN, Farsides B. Public trust and 'ethics review' as a commodity: the case of Genomics England Limited and the UK's 100,000 genomes project. Med Health Care Philos. 2018 Jun;21(2):159-168. doi: 10.1007/s11019-017-9810-1.
93. Horton R, Lucassen A. Ethical considerations in research with genomic data. The New Bioethics. 2023;29(1);37-51. https://doi.org/10.1080/20502877.2022.2060590; Horton R, Lucassen A. Ethical issues raised by new genomic technologies: the case study of newborn genome screening. Cambridge Prisms: Precision Medicine. 2023;1:e2. doi:10.1017/pcm.2022.2. https://doi.org/10.1017/pcm.2022.2
94. Farsides B, Lucassen AM. Ethical preparedness and developments in genomic healthcare. Journal of Medical Ethics. Published Online First: 02 June 2023. https://doi.org/10.1136/jme-2022-108528

5.2 Developing an ethical framework for ethical preparedness

Drawing on the insights that emerged in both the empirical and conceptual research conducted as part of the EPPiGen collaboration (see sections 2–4), we identify below four interconnecting values that we suggest will play an essential role in enabling and promoting such ethical preparedness in genomic medicine and research, illustrating them with quotations from participants from across the multiple strands of EPPiGen research. We then go on to consider how these values could support ethical decision-making at the multiple different levels of responsibility that we have categorised above: at the level of individual health professionals and researchers in managing their own practice; at the level of institutions in providing the circumstances in which ethical practice is supported and enabled; and at the level of local and national policymakers in recognising the role of policy in enabling or hindering ethical practice. Recognising the agency of patients and families, we have further identified questions for them, that seek to help them navigate their journey through the genomic system, without adding further to the burden of responsibility they already have to shoulder.

RELATIONALITY

I think it is a collective journey … all the benefit's going to be for the wider family [patient/participant]

A warm welcome comforting as tea and toast. / I felt heard and at ease [parent/participant]

It was a LOSS when the paediatrician moved away [patient/participant]

It's the ethics but it's also the direct interaction… the community reflecting together… the sharing of questions and also the support [health professional]

EPPiGen's research shows the importance of relationality at numerous levels. First, it illustrates the need for policymakers and practitioners to look beyond genetic connections and take account of how genetic diagnoses and treatment have potential to have an impact on *all* those whose lives are linked (whether genetically or otherwise) with the person concerned.

Second, the nature and quality of the professional relationships involved in genomic medicine – between health professionals and patients/families, within clinical teams, and within and across the health system – constitute an essential element of ethical practice. Patients and families contributing to EPPiGen highlighted the transformational nature of sensitive and caring relationships with health professionals, and the distress, sometimes even trauma, when these were found to be absent, or when NHS structures hindered the possibility of such relationships being formed. Health professionals similarly recognised the importance of such relationships and found it very difficult when systemic constraints prevented them giving the care they aspired to, emphasising the need for supportive colleagues, environments and investment to enable them to provide such care.

Third, genomic medicine is, by its nature, concerned with families and populations as well as individuals, and this can create challenges when genetic information with potential relevance to the health of others is found. EPPiGen's research indicated widespread support for the idea that family members should be able to access genetic information with potential to impact on their own health, while illustrating how in practice this can be challenging to achieve. It also reiterates the importance of the respective and meaningful relationships between researchers and potential participants in achieving more diverse and equitable participation in genomic research.

SUPPORTING AGENCY

Doing something for other women like me [patient/participant]

Genius though all this is, do these hieroglyphs/ Tell us about her bawdy laugh, and a smile to fall in love with? [parent/participant]

No-one is in charge of my care [patient/participant]

Who are these planners these architects/ these policy makers / who create the world in inaccessible ways? [parent/participant]

EPPiGen contributors illustrated vividly how patients and their families exercise agency both in their day-to-day lives (in which 'the clinic' may play only an occasional or intermittent role) and in the way they seek and manage a genetic diagnosis (or the wait for one). While it is widely accepted that patients and families should be at the heart of all developments in genomics, in practice, health service pressures, the way that services are organised, and perceived disparities in power between professionals and patients, can act to undermine that capacity for agency, leaving patients and families frustrated and disempowered. Professionals, too, may experience lack of agency because of institutional constraints that hinder their ability to provide the care and support they would wish to offer, or which raise expectations they cannot meet. A common theme in the patient and family experiences shared with EPPiGen was that of feeling over-burdened by the practicalities and complexities of navigating the health system, and the importance of professional support in better managing these challenges, in order to free up time and emotional energy for ordinary day-to-day family life 'outside the clinic'.

OPENNESS

Sorting through the 'building blocks' of life ended up feeling more like interpreting abstract art, with different people seeing and valuing different aspects [researcher]

Uncertainty and acceptance: what does the future hold? [patient/participant & family]

The wider we look, the more uncertainty we invite [researcher]

Two strong themes emerging from EPPiGen's research include the **uncertainties** inherent in the interpretation of many genomic findings and the **importance of context** for the implications of such findings for individual patients and their families. These two features of genomic medicine highlight the importance of openness to different perspectives and the significance of different contexts on the part of all professional stakeholders, from individual researchers and health professionals to policymakers. This includes, for example, openness to diverse perspectives on what genomic findings mean for different people; and openness to the possibility that the evolving evidence base may require a change of policy direction. Further, a sensitive and open approach to communication helps promote transparency with respect to the uncertainties inherent in many genetic findings and also prompts health professionals to be sensitive to the way that some terminology or uses of language can be distressing for patients or lead them to feel that conversations have been closed down.

TRUSTWORTHINESS

Such brilliant stuff is going to come from it, that you just suck it up almost [patient/participant]

I sat down with someone who was really interested in me, and spent some time with me, and explained things to me [patient/participant]

And then we waited about three years, which felt so long [patient/participant]

Don't make promises that you can't keep [patient/participant]

Relationships in genomic medicine, between health professionals and patients/families, between professionals, and across different parts of the health system, are all predicated on trust – which in turn relies on trustworthiness. Demonstrating trustworthiness requires honesty and clarity about the likely outcomes for patients and their families in participating in a hybrid system of care and research – and in particular of the likelihood of benefit to individuals now as well as contributing to future public good. Concerns expressed by both patients and their families and by health professionals about unrealised hopes and expectations highlight how policymakers need to be confident that professionals and institutions have the resources, skills and support to be able to deliver what the public is being promised, before such promises are made.

Questions for policymakers to consider

RELATIONALITY

How do we prioritise the need to support good relationships in genomic medicine services – recognising that these are as important as technical capacity in providing excellent genomic medicine? How do we build services that recognise the familial nature of genomic information?

SUPPORTING AGENCY

How do we help ensure that patients feel supported and empowered through often lengthy and sometimes unresolved diagnostic journeys? How do we simplify and streamline navigation of health systems to ensure patients do not have to fight to make the system work for them?

OPENNESS

How do we make sure our decision-making processes include diverse perspectives – including from people whose voices are currently not being heard? Are we open to moving away from as well as leaning into genomic technology as guided by evidence? Are we open about all the factors that influence our decision-making?

TRUSTWORTHINESS

Are our public announcements on genomics supported by good evidence on what can be delivered, and clear as to whether benefit is likely to be immediate or in the future? Where we make promises, are we sure they can be kept? And what do we need to do to support greater public understanding of the complexities and uncertainties of genomics?

Questions for healthcare and research institutions to consider

RELATIONALITY

How can the healthcare staff in my institution be supported within a community of practice, so that they are well-placed to work alongside patients and their families?

SUPPORTING AGENCY

How can genomic medicine services, or genomic research, be organised in my institution so that patients and their families are supported and cared for through the whole system and across all the institutions involved, and empowered to ask for what they need?

OPENNESS

What do we need to do to support an organisational culture where open communication of uncertainty is the norm? What do we need to do to support an organisational culture which encourages changing course where appropriate in response to new evidence?

TRUSTWORTHINESS

How can we ensure that we plan and structure our services to meet the needs of patients/participants without raising expectations that we cannot meet?

Questions for health professionals to consider

RELATIONALITY

How do I create spaces and encounters that make people feel safe and respected – both patients and colleagues?

SUPPORTING AGENCY

What do I need to 'listen for' with this patient and their family, so that I can best support them in what is most important to them, treating them as an equal partner in their care?

OPENNESS

How can I be alert to my use of language and its impact on each individual patient and their family?

TRUSTWORTHINESS

Have I been clear about the likely benefits of this research or these tests, so that patients and their families understand whether or not they are likely personally to benefit?

Questions for families to consider

RELATIONALITY

What relationships and values are important to me that I want my health professionals to be aware of and sensitive to?

SUPPORTING AGENCY

What other organisations can I look to for support, advocacy, and a sense of community?

OPENNESS

What would help me ask questions, and challenge difficult language and encounters where these arise?

TRUSTWORTHINESS

What processes could help strengthen and, if needed, repair my trust in genomic medicine? How can I communicate this?

6

RECOMMENDATIONS

In the spirit of the collaborative approach underlying the EPPiGen project, the recommendations set out below are conceptual rather than concrete, in order to leave space for specific tangible actions to be co-developed and co-produced with those who are directly involved. Following the same structural approach as in our ethical framework in section 5 (distinguishing the roles of policymakers, institutions, health professionals and patients/families), we indicate issues that need to be grappled with as a matter of priority if the positive futures envisioned in UK genomic policy are to be successfully achieved. We note that 'policymakers' is a very general term, and that those who influence policy operate at many different levels: here, we use the term to refer to those influencing national or local policy other than through direct responsibility for running institutions or directly providing clinical services.

At policy level, action to support ethical preparedness should include:

- Finding ways for policymakers to draw on a wider range of perspectives and experiences in genomic medicine – incorporating, for example, the particularly challenging experiences of people living with uncertain genomic findings;
- Developing a more nuanced public debate around genomics, supporting greater public understanding of the messiness and uncertainties often associated with genomic findings – drawing, for example, on the creative outputs produced by EPPiGen collaborators;
- Recognising the need for greater support for patients and their families throughout their 'genomic journeys' (often also involving multiple other specialists and departments within the healthcare system), alongside the need for clarity as to where responsibility lies to provide that support;
- Ensuring that patients and their families have access to the information, resources and informal networks that they need in order to make sense of their own situation and find support when they need it – including through funding for patient organisations that take on this role.
- Being open to the role that non-genomic approaches can play in meeting needs, and holding genomics to the same standards as other tests in order to be adopted into policy.

At the institutional level, action to support ethical preparedness should include:

- Drawing on patients' experiences of using genomic services, to ensure that these 'hybrid' research and care services are managed and communicated in ways that enhance patients' understanding of whether, when and how they may personally benefit;
- Creating and resourcing spaces where health professionals can be reflexive and find support from colleagues in handling ethically difficult situations – building for example, on the model of the Genethics Forum to help develop and maintain a community of practice;
- Helping maintain an institutional culture that values such a community of practice, that recognises the moral distress experienced by health professionals when practical constraints limit the care they are able to provide, and works to remove these constraints;
- Working with patients to ensure that patient journeys that involve genomic medicine are well-integrated with other departments and specialties, and that patients have the professional support they need to navigate the system.

At the professional level, action to support ethical preparedness should include:

- Access to resources (relevant to all levels of health professional education, from undergraduate to continuing professional education) that support reflective, ethical and compassionate practice in the context of genomic medicine – building, for example, on the materials produced by patients, participants and families throughout the EPPiGen project, and on the resources being developed from past Genethics Forums, to support health professionals in managing the uncertainties involved in many genomic findings and responding to the diverse contexts of their patients' lives.

At the family level, action to support ethical preparedness should include:

- Encouragement and opportunities to share experiences with other families where appropriate.
- Creating spaces and ongoing opportunities for those who want to share their stories for this to be incorporated into the training and development of health professionals

Appendix 1: Methodologies

EPPiGen methodology at BSMS

At Brighton and Sussex Medical School our work has focussed on understanding how the promise and challenge of genomic medicine is understood and experienced by those engaging with the service – initially through working with non-genomic specialists and then with patients and their families. Our central goal has been to understand people's hopes, expectations, and worries, and to provide an outlet for reflecting on what everyday life is like at a time when so much focuses on the promise of genomic medicine, exploring how the affective and promissory discourses surrounding genomics are (re)shaping social worlds and lived experiences.

In our work with GPs and hospital doctors we sought to replicate the methodology engaged by Farsides and collaborators in a series of earlier projects. Our intention was to combine ethnographic study, in depth interviews and participation in Ethical Discussion Groups to form a detailed and nuanced view on the views and attitudes of professionals negotiating the proposed mainstreaming of genomics within the NHS. We soon realised that this methodology, which had yielded such rich data and elicited enthusiastic engagement in a number of very different settings between 2000 and 2017, was not suited to the NHS we were now confronted with. This realisation became even more stark post Covid, where pressures on staff and resources meant that a second planned project relating to the introduction of new-born screening became unfeasible. We have reflected on this, and realise that whilst regrettable, it is important to ensure that qualitative research methods are responsive to the changing environments within which one chooses to work.
Regarding our work with patient participants and families, taking inspiration from the work of disability studies scholar Kirsty Liddiard, our aims have been to enable our participants to situate the stories against and amongst 'the myriad stories already told about their lives by 'experts''. In doing so, we have been keen to think not just about how our work might just enable us to learn from our participants, but also how it might enable health professionals to learn from these narratives. Thinking about how accounts of patient experience might contribute to the preparedness of clinicians to deal with the ethical challenges of genomics practice has prompted us to think imaginatively, creatively, and critically about just how patient experiences can be collected, collated, curated, and disseminated.

Our methodological approach is influenced by trends within the social sciences that encourage researchers to evoke, not just explain. Specifically, we have been encouraged by the practice and promise of arts-based research, a rigorous sub-genre of qualitative research that uses creativity and artistic expression to create space for people to express and evoke aspects of lived experience in productive and affective ways, beyond what is often possible through more conventional social-scientific registers.

In practice, this has involved working with a group of people with lived experience of rare genetic disease to explore different ways of creating representations, stories, and conversations about the patient experience of genomic medicine. We had the privilege to work with this group over four years, building deep and trusting relationships. This group has shaped our research throughout, guiding our development of questions, methods, and dissemination. The group became collaborators rather than simply participants. Co-production and empowerment have been at the heart of our research – our focus has been on participatory ways of doing research with people with lived experience, rather than conducting research 'on', 'for', or 'about'. Indeed, it was conversations with participants at the outset of our research that indicated an interest in, and encouragement to, explore ways of researching experiences of genomics using arts-based methods. Our approach within this overarching framework has been to identify arts-based practices that:

1) Had an established lineage as a research method.

2) Attracted and offered something new to our participants – both as a modality of expression and as a new skillset and experience.

3) For which we were able to identify an experienced practitioner who could work sensitively to create a space for participants to share their stories in a way that connected to an artistic tradition.

The goal throughout this process has been to empower participants to share rich, vivid, and affective creative artefacts that might challenge, reveal, and provoke understandings of the experiences of families affected by rare conditions. Broadly, our way of working involved:

1) Introducing participants to a particular creative mode of expression with the help of appropriate expert practitioners, enabling them to familiarise themselves with the modality, its traditions, and experiment with using it to tell stories.

2) Giving participants the time, space, resources, and guidance to empower them to confidently explore their experiences through creative means.

3) Supporting participants to choose if they would like to share any of their creations with us as researchers and/or the rest of the group, and ultimately a wider public.

4) Conducting discursive interviews or focus groups with participants to, firstly, explore their experiences of creating, the stories they have been able (or not able) to tell and the impact of engaging (or not) with other people's works. Secondly, to allow us to learn more about the intent and experiences behind their creations.

Obviously, each creative practice has brought its own unique opportunities and challenges, and we have detailed our methodological processes in much finer-grain detail in peer reviewed journal publications:

- Gorman R and Farsides B (2022) Writing the worlds of genomic medicine: experiences of using participatory-writing to understand life with rare conditions. Medical Humanities 48(e4). https://doi.org/10.1136/medhum-2021-012346
- Gorman R, Farsides B and Gammidge T (2022) Stop-motion storytelling: Exploring methods for animating the worlds of rare genetic disease. Qualitative Research 23(6): 1737–1758. https://doi.org/10.1177/14687941221110168
- Gorman R, Farsides B and Bonner M (2023) Crafting representations of rare disease: collage as qualitative inquiry. Arts & Health 16(3). Taylor & Francis: 285–302. https://doi.org/10.1080/17533015.2023.2254328
- Gorman R and Farsides B (2024) Mail art methods and the social and cultural geographies of families affected by rare disease. Social & Cultural Geography 1–23. https://doi.org/10.1080/14649365.2024.2416672

We were conscious of accommodating the availability of people with often complex caring responsibilities, and at the outset of the project, engaging with those affected by vulnerabilities in pandemic times. Resultingly, we organised our work online. Online mediums are well established as enabling positive researcher-participant relationships and allowing for the collection of rich and rigorous data. The option to "blur" or have artificial backgrounds also allows people to feel more comfortable in a familiar home environment and created an ethos of inclusivity for those who sometimes needed to disappear off screen to attend to family responsibilities – people who would normally not be able to participate in in-person events. Working online allowed us to engage with a geographically dispersed group of participants with significant caring responsibilities. However, it required thinking creatively and finding ways to adapt hands-on creative practices into something that could be taught and facilitated remotely. Online research can also sometimes leave participants feeling disconnected from the researchers. Aware of the disembodied nature of the research, we sent participants small 'care packages' of resources ahead of the creative workshops to show our appreciation and to help build a sense of occasion.

Our work here has also contributed to the development of scholarship around creative methodologies, showcasing how the EPPIGEN project has driven methodological innovation, developing a strong suite of novel participatory and creative research strategies capable of generating engaging and accessible ways of working. Our methods have enabled our research to create a space where people feel comfortable to explore different narratives, centre different identities, and challenge assumptions, whilst providing different modalities of knowledge (re)presentation, production, and dissemination.

Working closely with our participant-collaborators, we have also been keen to produce a greater diversity of outputs beyond academic publications to engage public and clinical stakeholders alike, as well as ensuring our participants had ownership of outputs from the project themselves. As part of this, we developed Helix of Love, a co-produced collection of poems from parents of children with rare diseases that explored how the hope surrounding new genomic diagnostic technologies are (re)shaping lived experience. Helix has received critical acclaim from stakeholders across the genomics sector (clinicians and patient communities) and was incorporated into the NHS-led International Genomics Education and Training Summit and distributed as a training resource to clinically qualified colleagues from around the globe. We are also committed to sharing the findings of this creative process of research, engagement, and dissemination with academic colleagues too, and a write-up of the background behind Helix is in process.

- Helix of Love: A collection of poems from parents of children with rare genetic conditions

Particularly, our creative data – poetry, collages, films, etc. – have generated data that can be shared in very immediate and emotively affective ways, not only by us as researchers, but also by our participant-collaborators. Our creative methods have provided us with powerful resources for communicating the lived experiences of families caught up amidst genomic excitement, blurring the boundaries between practices of research, practices of engagement, and practices of dissemination. The mediums through which stories are told are important in effecting what stories are told – and what stories go on to be shared.
From the outset of our research, we have been keen to reflect on the role of story and storytelling in social science research, and were particularly inspired by the words of Emilie Cameron:

> Stories express something irreducibly particular and personal, and yet they can be received as expressions of broader social and political context, and their telling can move, affect, and produce collectivities [. . .] even if we cannot know in advance where our stories will lead.

We know that stories have lives, that stories travel, that stories remain memorable. We hope that the creative outputs produced through our creative methodological approach might prompt greater understanding of the lived experiences of families affected by rare disease.

EPPiGen methodologies used at Oxford/Southampton: research programme and design

1. Overview

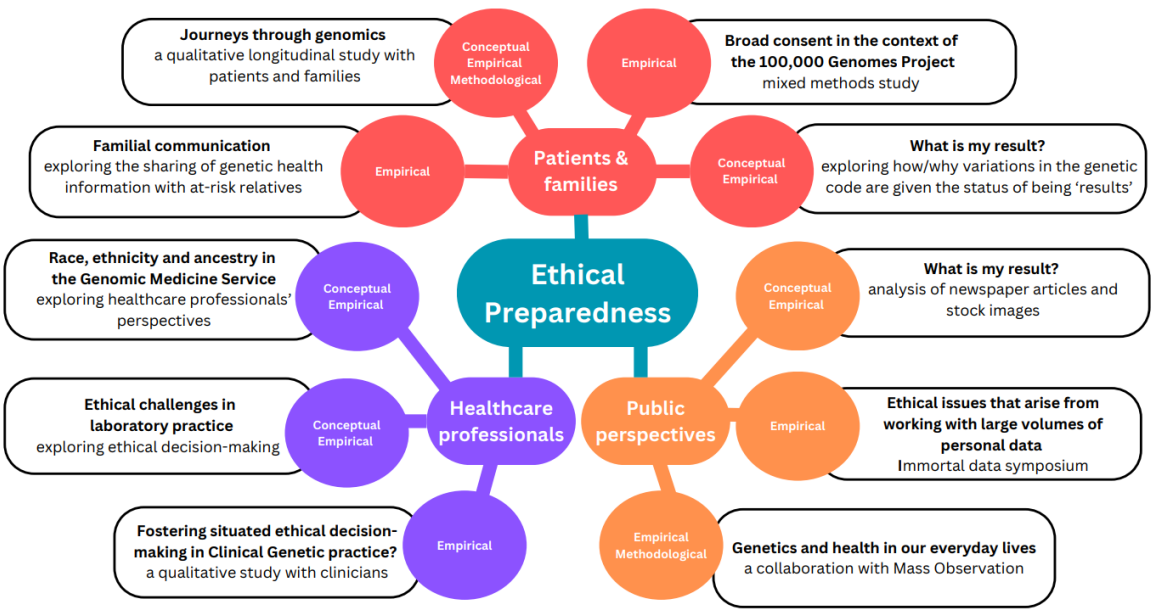
Our aim was to examine how the promise and challenge of genomic medicine is understood and experienced by those providing and engaging with the service and to identify the resources and support required to ensure that healthcare professionals, patients and families are ethically prepared to deliver/receive whole genome test results and a mainstream genomic medicine service.

This work has been undertaken by the Clinical Ethics, Law and Society Research Group (CELS) based at the Universities of Oxford and Southampton. CELS is an interdisciplinary team exploring the ethical, legal and social aspects of scientific and technological advances in healthcare. The team comprises clinical academics and those with research backgrounds in health psychology, political science and sociology.

2. Research questions

We designed a range of conceptual, empirical and engagement projects (see diagram below for an overview) which, collectively, sought to address the following research questions:

1. How does the transition of genomic medicine from a specialist to a mainstream medical service change practice for a spectrum of professionals and patients, as genomic medicine traverses medical practice, laboratory settings, and patients' lived experiences?
2. What kinds of ethical and social challenges are generated through these new modes of practice?
3. How prepared are those involved in delivering and receiving genomic medicine to face the challenges it presents, and what resources do they draw on in doing so?
4. What can genomic medicine learn from other areas of healthcare experiencing similar issues?



Overview of the projects undertaken by the Oxford-Southampton team

3. Conceptual research

The team has conducted a range of conceptual work. This included, in collaboration with the BSMS team, the development of ethical preparedness (Farsides and Lucassen 2022). Using [fictionalised] case studies from clinical practice, we have also examined the ethical issues that arise from genomic medicine including the challenges of using whole genome sequencing in newborn screening (Horton and Lucassen 2022), the importance of putting expectations about polygenic risk scores into context (Sud et al. 2023) and the capacity of regulatory systems to accommodate the increasing blurring of research and practice (Lyle et al. 2023) On-going work includes using a multimodal critical discourse approach to analyse representations of genetics and genomics in stock images (Horton et al. 2024), and the portrayal of genomic results in the UK media.

We have also drawn on our wide-ranging expertise to offer new perspectives. For example, we have employed different sociological lenses to examine aspects of the data, including Ruth Levitas' (2013) *Utopia as Method* to explore how participants mobilise genomic data to construct different desirable futures and Glen Elder's (1994) concept of linked lives from the life course theory to (re)consider who constitutes the patient in genomic medicine (Weller et al. 2022; Lyle et al. 2024). A model from Behavioural Sciences was used to conceptualise ethical preparedness in healthcare and health research settings (Samuel et al. 2022).

4. Empirical research

4.1 Participants

Our programme of empirical work is on-going. To date, **over 200 people** involved in delivering and receiving genomic medicine services have participated in our qualitative projects, with **hundreds more taking part in a range of public engagement activities** (see Appendix 3).

Across the projects, participants comprised:

- **Health professionals:** nurse practitioners, genetic counsellors, clinical geneticists, clinical scientists, bioethicists
- **Individuals and families:** patients, parents of patients, partners/spouses, and adult children
- **Publics:** those with direct/indirect experience of genomic medicine and those without

We have employed a purposive approach to sampling, which has a theoretical logic that precludes the need for a large sample. Rather, sampling is concerned with capturing the richness and depth of experience of a process or journey.

4.2 Recruitment

Healthcare professionals were recruited through:

1) The Genethics Forum
2) NHS England's Genomic Laboratory Hubs
3) Clinical genetics departments
4) Snowball sampling
5) Professional networks

Patients and families were recruited via their involvement in:

1) The 100,000 Genomes Project: participants from one Genomic Medicine Centre, covering nine NHS trusts, were sent a postal survey the purpose of which was to explore participants' views of the consent process. A small sample of those who indicated a willingness to partake in an interview were invited to participate in the QLR study.

2) The NHS Genomic Medicine Service: key gatekeepers, primarily healthcare professionals, helped facilitate recruitment by distributing study information. In both cohorts, significant others were recruited via snowballing.

3) Patient support groups: who advertised the project via their networks and/or social media.

Publics were invited to take part:

1) through collaborative work with organisations such as Mass Observation

2) via Science Festivals (e.g. Southampton Science and Engineering Festival, Northern Ireland Science Festival and the national ESRC Festival of Social Science).

The purpose of qualitative work is to get as broad a sample as possible to maximise transferability and therefore the implementation of findings.

4.3 Methodologies

Three key methodological approaches were employed:

- **Narrative inquiry design**: is a qualitative approach that explores individuals' lived experiences through their personal stories, emphasising context, meaning, and interpretation. The focus is on how people construct and share their experiences over time, often includes interviews, observations, and document analysis. Narrative inquiry was particularly apt for examining the ways in which lab professionals articulated the evolution of their practice and the ethical challenges they navigated.

- **Qualitative longitudinal research (QLR):** is an approach that prioritises time and temporality. Such an approach seeks to explore change and continuity over time and the relationship between the lives of individuals, those in their networks, and wider social processes. We developed a QLR study to document patients' and families' journeys through genomics, from querying the potential of a heritable tendency, through to making decisions for, about and/or with relatives, receiving (certain or uncertain) findings, and living with a result(s) or uncertainties (Weller et al. 2022, Wanat et al. 2024).

- An **Implementation science approach:** focuses on studying methods to promote the systematic adoption and integration of evidence-based practices, interventions, or policies into real-world settings. It examines factors that influence implementation, evaluates strategies to improve effectiveness, and ensures sustainability across various contexts. This approach was particularly apt for working with healthcare professionals to explore how ethical challenges present and are experienced and was also used in conjunction with a behaviour change model (Samuel et al. 2022).

4.4 Methods

In line with the above methodologies, three key methods were used across the projects:

- **In-depth interviews:** form the backbone of qualitative work and were used across multiple studies to explore experiences, perceptions, and emotions in rich detail. For example, narrative interviews were used to explore ethical issues in laboratory practice, whilst repeat interviews were used in the QLR study to capture participants' experiences over time and during critical moments in their journeys. In-person interviewing featured in the original design of most of the projects but, as a result of social distancing measures introduced in response to the Covid-19 pandemic (and subsequently changing research practice), remote modes of interviewing were also used. These included synchronous video and audio-only, and asynchronous email interviews.

- **Written accounts:** were gathered via a collaboration with Mass Observation; a longstanding national social research project that supports a panel of public participants from across the UK to write about topical issues. A panel of public participants contributed accounts that described direct/indirect experiences of genetics, and included responses to fictional scenario involving ethical decision-making, and imaginings of future applications. Respondents were encouraged to write freely, use a range of mediums and to structure their responses as they wished. The long-standing relationship that many had to Mass Observation meant that accounts were often detailed and candid.

- **Participatory and creative methods:** were embedded in some of the projects with some instigated by participants. For instance, unprompted, creative inputs such as hand-drawn family trees, timelines and artefacts symbolic of their journeys (e.g. files full of hospital correspondence) were incorporated into interviews. Other initiatives focused on co-production. Examples included a collaborative project with a sub-sample of participants, an artist and an animator to co-produce a set of visual resources illustrating the complexity of participant's journeys (Lyle et al. 2024). Other participants were involved in a collaboration with HIVE Choir, a vocal ensemble based in Belfast, to co-produce songs highlighting the emotional dimensions of their experiences.

4.5 Analytic approaches

Across the projects a range of analytic approaches were used, each aligning to the project's aims and the conceptual or theoretical framework employed:

- **Thematic analysis:** is concerned with identifying recurring themes in rich, descriptive textual data. This is achieved by coding deductively and/or inductively an interview transcript, exploring links and relationships between codes, and establishing themes. Thematic analysis was used across many of the projects. For example, to look at needs of genetic healthcare professionals in ethical decision-making, as well as, in interviews with patients that explored how and why variations in the genetic code are given the status of being results. In addition to conducting thematic analysis across one dataset, the team also employed a collaborative approach pooling and working across datasets to gain new insights (e.g. Lyle et al. 2023).
- **Narrative analysis:** focuses on interpreting and making sense of the stories people tell about their lives. It examines how individuals construct meaning through narratives, with analysis focusing on the structure of the plot(s), recurring and/or contradictory themes, use of language, and salience of context. We used narrative analysis to explore how patients and families articulate, construct, and represent patienthood in the context of genomic medicine.
- **Qualitative longitudinal analysis (QLA):** has a three-dimensional logic encompassing emphases on cases (depth), themes (breadth) and processes (temporal sensitivity) (Neale 2021). QLA is founded on abductive reasoning which involves seeking explanations for gaps in theory or unusual/unexpected facets of empirical data by bringing into conversation ideas and theories previously disparate and then working reflexively and iteratively between theory(ies) and rich empirical data. The related logic of retroduction, is apt for examining retrospective accounts, encouraging the researcher to look back to understand the past. This approach has been central to our QLR study exploring the experiences of patients and families.

Appendix 2: Academic outputs from EPPiGen

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Ballard LM, Horton RH, Dheensa S et al. Exploring broad consent in the context of the 100,000 Genomes Project: a mixed methods study. European Journal of Human Genetics 2020;28:732–741. https://doi.org/10.1038/s41431-019-0570-7

Ballard LM, Band R, Lucassen AM. Interventions to support patients with sharing genetic test results with at-risk relatives: a synthesis without meta-analysis (SWiM). European Journal of Human Genetics 2023;31:988–1002. https://doi.org/10.1038/s41431-023-01400-1

Carley H. How can we foster situated ethical decision-making in clinical genetic practice? 2023. MSc in Clinical Genomics 2022-2023

Dheensa S, Samuel G, Lucassen AM, et al. Towards a national genomics medicine service: the challenges facing clinical-research hybrid practices and the case of the 100 000 genomes project. Journal of Medical Ethics. 2018;44:397-403. https://doi.org/10.1136/medethics-2017-104588

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Gorman R, Farsides B, Gammidge T. Stop-motion storytelling: Exploring methods for animating the worlds of rare genetic disease. Qualitative Research. 2023;23(6):1737-1758. https://doi.org/10.1177/14687941221110168

Gorman R, Farsides B, Bonner M. Crafting representations of rare disease: collage as qualitative inquiry. Arts & Health. 2023. https://doi.org/10.1080/17533015.2023.2254328

Gorman R, Farsides B. Mail art methods and the social and cultural geographies of families affected by rare disease. Social & Cultural Geography. 2024; 1–23. https://doi.org/10.1080/14649365.2024.2416672

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Horton R, Fenwick A, Lucassen AM. Old consent and new developments: health professionals should ask and not presume. Journal of Medical Ethics. 2020;46:412-413. https://doi.org/10.1136/medethics-2019-105868

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Samuel G, Horton R, Weller S, Lyle K, and Lucassen A. Genome sequencing: challenges for equity and sustainability in an age of big data. In: Data & Society Sage Handbook 2025.

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Appendix 3: Engagement and dissemination

Engagement and dissemination: EPPiGen work at BSMS

From the outset, engagement and dissemination has been an important element of the project, and one which continued in a vein of co-production and co-ownership.

The list below illustrates the wide and deep reach of the project's outputs, and the receptiveness of professional audiences, policy makers and political actors to the products of innovative arts-based research.

The success of our dissemination and engagement programme has fulfilled our promise to our participants to 'make their voices heard', and should provide encouragement to those who are working to expand understanding of lived experience through creative research interventions.

June 2019 BSA South Coast Symposium BSMS Ethical Quandaries: Blurred boundaries and transformation in Genomic Medicine https://www.bsms.ac.uk/research/clinical-and-experimental-medicine/theoretical-and-empirical-bioethics/eppigen-posts.aspx

September 2019 Keynote address to the Annual Scientific Meeting of the Hong Kong College of Community Medicine Meeting the Challenge of Delivering Genomic Medicine : The Case for Ethical Preparedness

October 2019 EPPiGen presentation University of Oxford, Ethox Centre Public Seminar series

February 2020 Creating Health and Wellbeing: Through Creative Endeavour(s) BSA sponsored workshop, BSMS

July 2020 Considering preparedness during a pandemic, Nuffield Council on Bioethics https://www.bsms.ac.uk/research/clinical-and-experimental-medicine/theoretical-and-empirical-bioethics/eppigen-posts.aspx

May 2022, Presentation to the ESRC's 'Methods North West' network, online.

June 2022, Presentation at the International Medical Geography Symposium, Edinburgh.

October 2022, Presentation to the Centre for Arts and Wellbeing Seminar Series, Brighton.

October 2022 Lake Como School of Advanced Studies, Fondazione Alessandro Volta, Villa del Grumello, Como, Italy

November 2022, BSMS EPPiGen resources displayed as part of a public engagement exhibition at Cambridge Rare Disease Network's RAREFEST event, Cambridge. https://www.camraredisease.org/?s=Farsides&et_pb_searchform_submit=et_search_proccess&et_pb_include_posts=yes&et_pb_include_pages=yes

January 2023, BSMS EPPiGen resources displayed as part of a public engagement exhibition at the Festival of Genomics, London. https://festivalofgenomics.com

May 2023 HDBI Public Dialogue project https://hdbi.org/ethics-seminars

June 2023, BSMS EPPiGen work featured as part of a radio show on West Wilts Radio. https://westwiltsradio.com/shows/the-poetry-place-with-peter-robinson-john-greening-42-25-06-23 at 31.20 mins

August 2023, BSMS EPPiGen resources featured in Rare Revolution Magazine.

September 2023, Presentation at the Royal Geographical Society (with Institute of British Geographers) Conference, London.

September 2023, Book launch of "*Helix of Love: A collection of poems from parents of children with rare genetic conditions*" developed as part of EPPiGen work, online.

October 2023, BSMS EPPiGen resources displayed as part of a public engagement exhibition at the Festival of Genomics, Boston, USA.

October 2023, BSMS EPPiGen team receive a letter from 10 Downing Street recognising the impact of *Helix of Love* in leading to 'greater understanding of the lived experiences of families affected by genetic conditions'.

November 2023, BSMS EPPiGen resources displayed as part of an exhibition at the International Genomics Education and Training Summit, Cambridge. BSMS EPPiGen team also took part in a panel discussion on 'The patient and family perspective'. Additionally, delegates at the conference (from over 49 different countries) were each given a copy of *Helix of Love* in their packs, as a way of embedding a focus on patient and family voices in genomics education and training.

December 2023, Panel presentation ("Pharma's Paradigm Shift: Harnessing the Power of Patient Innovators and Disrupters for Healthcare Transformation") at the Faculty of Pharmaceutical Medicine's Annual Symposium, London.

December 2023 PET Annual Conference plenary panel Ethical Preparedness and Embryo futures

January 2024, Presentation at The Profound and Multiple Learning Disabilities (PMLD) Conference, online.

January 2024, BSMS EPPiGen resources displayed as part of a public engagement exhibition, and used as part of the opening plenary, at the Festival of Genomics, London.

January 2024, *Helix of Love* added to the Thackray Museum of Medicine collection.

February 2024, BSMS EPPiGen resources used as part of Rare Disease Day events and communication by Genomics England.

March 2024, a BSMS EPPiGen research participant receives a letter from Sir Keir Starmer thanking them for sharing a copy of *Helix of Love*, noting its emotive content.

May 2024, Presentation at the Collaborative Futures Academy: Emotions in Engagement, Cambridge/Berlin.

May 2024, Poster and digital presentation at the European Conference on Rare Diseases, Brussels.

September 2024, Presentation to the Social and Ethical Research in Genomics Network, Warwick.

November 2024, Presentation to Sheffield Institute for Translational Neurology, Sheffield.

November 2024, BSMS EPPiGen experiences of developing creative approaches for conducting qualitative research and enabling engaging, equitable, and accessible ways of working with participants used as a case study of innovation in participatory methods by the Institute of Development Studies.

January 2025, Workshop hosted at BSMS reflecting on developing Ethical Preparedness in the wake of the Infected Blood Inquiry.

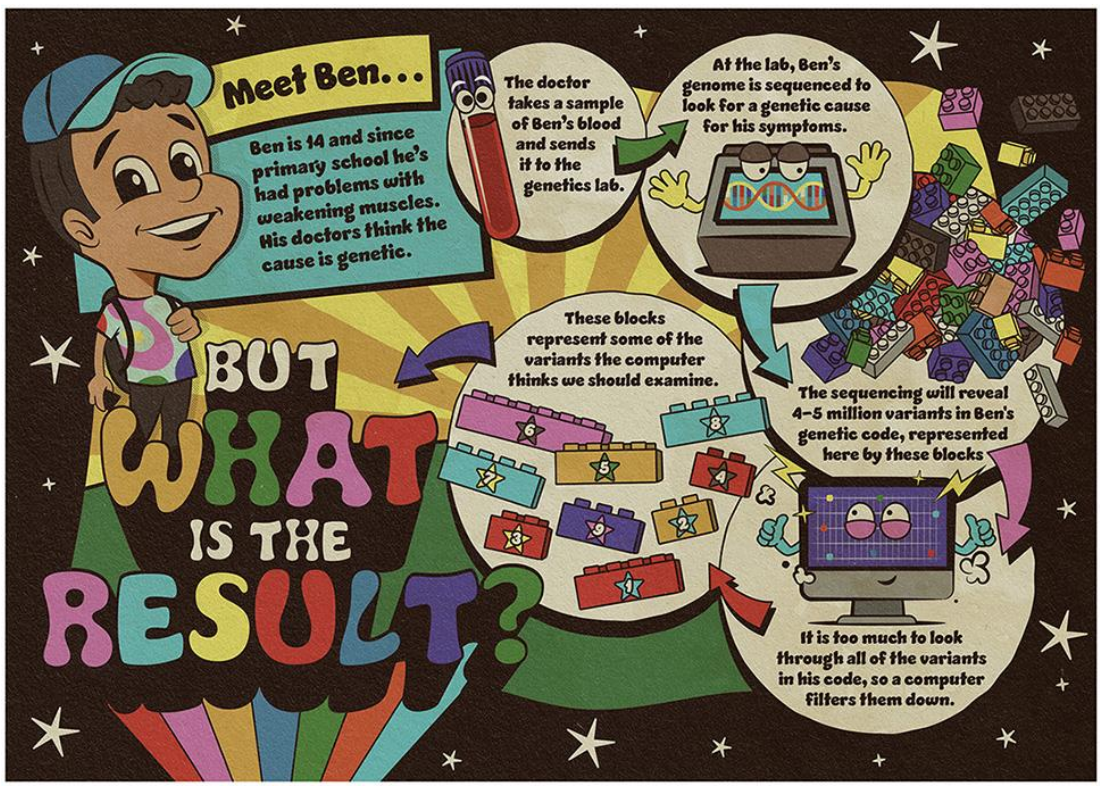
January 2025, BSMS EPPiGen resources displayed as part of two separate public engagement exhibitions at the Festival of Genomics, London.

February 2025, BSMS EPPiGen resources displayed as part of an exhibition at the International Genomics Education and Training Summit, Athens.

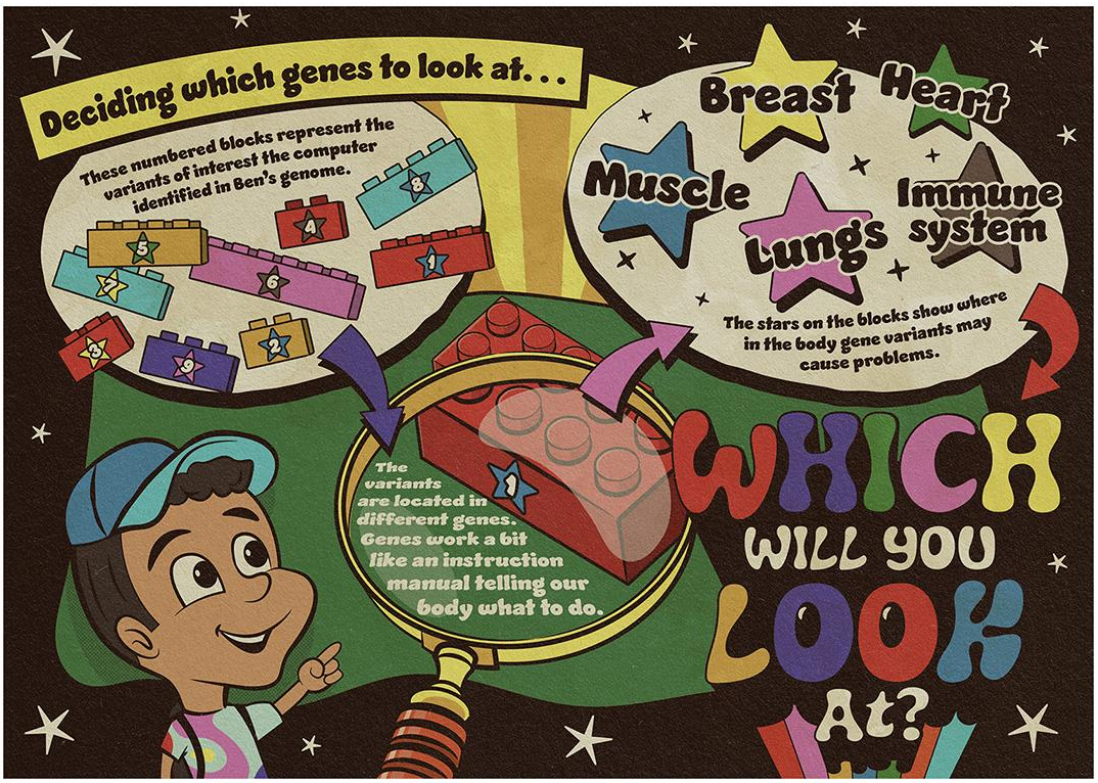
Engagement: EPPiGen work at Oxford/Southampton

- **Songs for genomics**: 'Songs of Genomics' was a creative public engagement project which focused on translating research findings about patient experiences of genomic medicine into song. The project was a collaboration between the EPPiGen CELS team, HIVE Choir – a vocal ensemble based in Belfast –, and the Sonic Arts Research Centre (SARC) at Queen's University. To date, the collaboration has hosted two events. The first formed part of the Northern Ireland Science Festival 2023, for which a repertoire of songs based on policy reports, EPPiGen publications, and anoymised data extracts was composed. The songs were performed at Belfast City Council's newly established community and cultural hub with the aim of communicating the complexities and lived experiences of genomic testing in an innovative and accessible way. The second event was hosted at Pegasus, an accessible and inclusive community theatre in Oxford. Those with experience of genomic testing participated in a collaborative song-writing workshop, which resulted in the co-production of five short songs. The existing repertoire and new song book were performed to a diverse audience as part of the ESRC Festival of Social Science 2024. The team was awarded the University of Oxford's Centre for Human Genetics prize for public engagement in 2023.

- **Genomic data: building blocks for life or abstract art?** The team developed a hands-on family-oriented activity for the Southampton Science and Engineering Festival 2023. This activity aimed to show how difficult it can be to understand how our genes can affect our health, and why it is not always easy to work out a patient's result from genetic tests. Using a fictional scenario of a young man, 'Ben' whose muscles were becoming progressively weaker, participants were encouraged to work through the process by which his results can be analysed. We used Lego blocks to demonstrate how analysing patients' genome tests is a bit like interpreting abstract art, in that different people might see and value different things. We have since published an article in Frontiers for Young Minds; a journal for/reviewed by young people adapting the activity into cartoon form (Horton et al. 2024).



95 https://cpm.ox.ac.uk/event/songs-of-genomics/


Deciding which genes to look at...
These numbered blocks represent the variants of interest the computer identified in Ben's genome.
Breast
Heart
Muscle
Lungs
Immune system
The stars on the blocks show where in the body gene variants may cause problems.
The variants are located in different genes. Genes work a bit like an instruction manual telling our body what to do.
WHICH WILL YOU LOOK At?


Deciding which variant to look at...
The blocks representing the variants from Ben's genome are colour-coded according to how sure scientists are about whether they're linked to disease.
Linked to disease
Probably linked to disease
Unsure
Probably not linked to disease
Not linked to disease
These variants could stop a gene from working properly and could cause problems.
We don't have enough evidence to know either way.
These variants aren't linked to disease, they're just part of the wide range of natural variation we all have in our genes.
WHICH WILL YOU LOOK At?

- **Open resources to support patients and healthcare professionals**: 'Journeys through Genomics' is a series of visual resources co-produced with patients and families to communicate their experiences of seeking genomic explanations for a health condition and the wider impact on their lives. The resources are embedded within EPPiGen's QLR study. The depiction of genomic medicine often focuses on its technological components and the speed by which genetic code can be analysed, but through these visual resources we present a dynamic and situated understanding of the challenges genomic testing presents for patients and families. The four illustrations and animation were co-produced with research participants, an artist and an animator and were designed to help future patients, families, and healthcare professionals understand the process, opportunities, and challenges they may face (see also Lyle et al 2024).

- **Mass Observation collaboration**: 'Genetics and Health in our Everyday Lives' was a collaboration with Mass Observation; an ongoing national social research project that supports a panel of public participants to write about a wide range of topical issues. Through a series of prompts, the panel of participants were encouraged to write freely about their own experiences of personalised care and genetic medicine (or their understandings of the experiences of those in their familial and friendship networks), to engage with a fictional scenario to explore the issues that genetic testing can raise, and to imagine how genetics might feature in our future lives. We received almost 150 accounts, many of which were incredibly detailed and candid. Our ongoing analysis is focusing on: personalised care in the context of current UK policy emphases; familial communication and ethical decision-making; and newborn genome screening.

- **The Secret Life of Immortal Data**: The Secret Life of Immortal Data symposium brought together experts from clinical ethics, computer science, bioethics, and industry to address critical challenges around 'immortal' digital data. The event explored three key themes: the nature of data ownership, consent mechanisms for future data uses, and ethical approaches to data repurposing. Distinguished speakers from academia and industry examined these issues in the context of current challenges across various sectors, including privacy concerns in big data and machine learning, ethical considerations in genomics research, and questions around personal data use in public health applications like COVID-19 contact tracing. Through interactive discussions between panellists and participants, the symposium generated insights and recommendations for responsible innovation in an evolving technological landscape.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