Genomic Testing

How can we ensure equitable access for patients with sarcoma?

Sarcoma UK
The bone & soft tissue cancer charity

What is sarcoma?

Sarcomas are uncommon cancers that can affect any part of the body, on the inside or outside, including the muscle, bone, tendons, blood vessels and fatty tissues.

About 15 people are diagnosed with sarcoma every day in the UK. That's about 5,300 people a year. There are around 100 different sub-types of sarcoma, which can be largely split into two groups:

- soft tissue sarcomas (e.g. leiomyosarcoma, liposarcoma, gastrointestinal stromal tumour)
- bone sarcomas (e.g. chondrosarcoma, osteosarcoma)

Sarcoma diagnoses make up about 1.4% of all cancer diagnoses in the UK.

About Sarcoma UK

Sarcoma UK is a national charity that funds vital research, offers support for anyone affected by sarcoma cancer and campaigns for better treatments. It is the only cancer charity in the UK focusing on all types of sarcoma.

Our policy team looks for evidence to develop policy that will influence key decision makers in the Government, NHS, and research communities. We want to make sure everyone affected by sarcoma has access to the best possible treatment and care.

Working across the UK to develop and drive policy solutions, we aim to bring about change by improving outcomes and services for patients with sarcoma.

policy@sarcoma.org.uk

sarcoma.org.uk/policy

Glossary

Foreword

Richard Davidson

Chief Executive, Sarcoma UK

'All patients with sarcoma deserve equitable access to the most up-to-date treatment and testing

At Sarcoma UK, our aim is that everyone who is affected by sarcoma gets the best outcome. At the core of this is ensuring that patients receive equitable access to the best possible care, including genomic testing opportunities.

Being diagnosed with any cancer is an isolating and lonely experience, but this is amplified for sarcoma patients who face agonisingly long waits for a diagnosis of a cancer with limited treatment options.

At Sarcoma UK, we are supporting more patients than ever; calls to our Support Line about diagnosis have increased by a third this year. However, support alone cannot tackle the wider changes needed to improve care for sarcoma patients. Genomic testing offers a much-needed breakthrough for sarcoma patients, enabling individual patients and clinicians to have a better understanding of disease and tailor treatment. Unfortunately, we know from speaking to people with sarcoma that access to genomic testing is a lottery.

To help address this problem, this project has spent the past year investigating the issues arising for patients with sarcoma, healthcare professionals, and specialist sarcoma centres regarding offering genomic testing. Sarcoma UK has consulted people affected by sarcoma, healthcare professionals and public health bodies to develop a set of recommendations to improve access to genomic testing.

We now need to work with policymakers to ensure the recommendations in this report become a reality. We need to collaborate with healthcare professionals to acknowledge and build on the gaps in knowledge and infrastructure that prevent all sarcoma patients from being offered genomic testing.

Sarcoma UK is committed to focussing on early diagnosis in the coming years. We will help to establish a Genomics Tumour Advisory Board, which will bring together sarcoma and genomic expertise to drive forward the recommendations. This report signifies the first big step in improving equitable access to genomic testing for sarcoma patients. We will passionately work towards the goals it sets out so that all patients with sarcoma are offered genomic testing as early as possible, giving them the best chance of survival.

Executive Summary

Why focus on genomic testing?

Since the launch of the NHS Genomic Medicine Service, Whole Genome Sequencing (WGS) became routinely commissioned on the NHS in England for sarcoma patients. As a result, genomic testing should now be offered as part of the normal diagnostic process to patients who may have sarcoma. Evidence shows that genomic testing can improve patient care, leading to more precise sarcoma diagnoses and targeted treatments. However, there is huge variability in access to genomic testing, with many patients having never heard of genomic testing, nor been offered it prior to or following a sarcoma diagnosis.

This report aims to explore the extent to which sarcoma patients are being offered genomic testing across the UK. We outline how we can change this story by influencing policy makers and starting a conversation about the need for genomic testing for all sarcoma patients amongst the public and healthcare professionals. Here we aim to provide a voice for sarcoma patients to influence the future of genomic testing. The report delivers a series of policy recommendations that aim to raise awareness of genomic testing to the public and healthcare professionals (HCPs), as well as ask governments and professional bodies to take action to help improve a patient's sarcoma journey. By improving equitable access to genomic testing, we can give sarcoma patients a better chance of referral for prompt and targeted treatments.

How we built our evidence base

Through this project we have been able to build a picture of sarcoma patients' experiences, Sarcoma Specialist Centres and hospitals' practices, and policies on commissioning on genomic testing in the UK.

- Sarcoma UK approached 123 patients from our Patient Involvement Network (PIN). Patients were given the option to complete a survey or be interviewed. This enabled patients and family members to share their experiences and provide an insight into whether they were offered genomic testing during their diagnostic journey.
- We consulted clinicians from Sarcoma Specialist Centres to provide insight into the centres' approach to genomic testing and what barriers may be present across different centres.
- Finally, Sarcoma UK reached out to Health Departments from the four nations and asked about their current position on the provision of genomic testing for sarcoma patients, any barriers to implementation, and future priorities.

This paper provides insight into our project findings, patients' stories, key barriers and potential solutions which could ensure that all patients have access to genomic testing and receive the best quality care.

Sarcoma UK are calling on policymakers to make equitable access to genomic testing a reality for all sarcoma patients. We recommend that:

1. **Awareness should be raised about genomic testing and its benefits for sarcoma patients.** When it is clinically appropriate, genomics can enable earlier diagnosis, more accurate prognosis, and targeted treatment. Therefore, it is important that patients and healthcare professionals are made aware of this.

2. **HCPs should be better trained to ensure the NHS workforce is fully equipped to deliver genomic testing to sarcoma patients.** NHS England and Genomics England; NHS Scotland; the Welsh Health and Social Care Department; and the Department of Health, Northern Ireland should roll out education and training programmes for healthcare professionals, delivering and supporting genomic testing to achieve improved outcomes in service delivery and patient care.

3. **Each Sarcoma Specialist Centre should have a dedicated genomics specialist or genetic counsellor.** This will ensure patients feel well-informed and prepared to make important decisions regarding genomic testing.

4. **Standardisation and coordination should be implemented across the UK to address health inequalities and reduce variation in access.** This includes establishing a standardised UK-wide protocol for genomic testing and patient consent, as well as measures to redress health inequalities and ensure equitable access to genomic testing for all sarcoma patients across the UK.

5. **Funding for genomic testing should be increased to provide the necessary infrastructure for the wider and equitable roll-out of genomic testing across the four nations of the UK.**

6. **NHS England and Genomics England should update rules on data sharing to protect patient data and support data sharing.**

Background

What is Genomics?

Genomics is the study of the entirety of a person's genome (i.e. genetic material). Our genome is composed of DNA, containing around 3 billion letters of code, which carries all the information our cells need to grow, develop, and survive. Almost 99.8% of our DNA is the same for everyone, but in the remaining 0.2% some differences can be harmful.

Genomics allows our DNA to be analysed and compared to thousands of others to identify these differences that may contribute to a disease. This can inform and personalise our healthcare, as it helps determine what treatment or intervention will work best.

Types of genomic testing

Panel sequencing or Next Generation Sequencing
Panel sequencing is the application of Next Generation Sequencing (NGS) technology to look at variants in a specific set of genes. This method is commonly used to pinpoint a diagnosis when a person has symptoms that may fit a wide array of conditions or when the suspected condition can be caused by variants in many genes.

Whole Genome Sequencing
Whole Genome Sequencing (WGS) looks at the whole genome. The main aim of WGS is to provide more information about a patient's diagnosis or to guide decisions around treatment. WGS is typically used when the suspected condition or genetic cause is unclear, and tends to be more cost effective than gene panel sequencing. It enables a wide range of variants in many genes to be tested and is widely used to identify novel genetic causes of rare diseases.

Who is Responsible for Genomic Testing in the UK?

While in Scotland, Wales and Northern Ireland, respective national NHS bodies lead provision of genomics, in England, there are multiple bodies that share responsibility for genomic testing and research.

NHS England

NHS England (NHSE) holds overall responsibility for genomic testing in England, and produces legislation, strategy and leadership for the bodies that co-ordinate and carry out the testing.

Genomics England

Genomics England partner with NHSE to provide diagnostics and technology for Whole Genome Sequencing.

Their aims are to:

- Work with NHSE to deliver and improve genomic testing to help diagnose, treat and prevent illnesses
- Accelerate research by providing the data and technology researchers need to better understand and create new treatments for rare illnesses
- Store patient data ethically and securely

Genomics Medicine Service

The Genomics Medicine Service (GMS) is the arm of the NHS responsible for achieving the NHS's aims in regard to genomic testing. It provides full national coverage for genomic testing to eligible patients, enforcing standardised and equitable access across regions. It is also responsible for giving patients access to clinical research and for building a genomic database to enable research and development.

The GMS is responsible for the National Genomic Test Directory, which sets out:

- Types of patients eligible for genomic testing
- Types of genomic testing patients are eligible for
- All technologies used for genomic testing
- Genomic targets that enable enrolment into clinical trials

Genomic Laboratory Hubs

Genomic Laboratory Hubs (GLHs) provide the infrastructure for genomic testing, delivering the NHS GMS. The GLHs work collaboratively on cancer genomics and all other types of genomic testing. There are seven GLHs that cover and coordinate care in different areas of the country:

- Central and South Genomic Laboratory Hub, Birmingham Women's and Children's NHS Foundation Trust
- East Genomic Laboratory Hub, Cambridge University Hospitals NHS Foundation Trust
- North West Genomic Laboratory Hub, Manchester University NHS Foundation Trust
- North Thames Genomic Laboratory Hub, Great Ormond Street Hospital for Children NHS Foundation Trust
- South East Genomic Laboratory Hub, Guy's and St Thomas' NHS Foundation Trust
- South West Genomic Laboratory Hub, North Bristol NHS Trust
- North East and Yorkshire Genomic Laboratory Hub, The Newcastle upon Tyne Hospitals NHS Foundation Trust

The 100,000 Genomes Project

The 100,000 Genomes Project was announced by the government in 2012, with an aim to sequence 100,000 genomes from patients affected by cancer and rare diseases, to drive the implementation of genomics in UK healthcare. This has led to groundbreaking insights and demonstrated that WGS can be used to uncover new diagnoses for people across a broad range of rare diseases.

Despite the rarity of sarcoma, it was ranked fifth for the number of patients' samples sent for sequencing. Over 1500 patients with sarcoma were recruited as part of the 100,000 Genomes Project to have their genomes sequenced. The UK collection of sarcoma genomes currently makes up the largest repository worldwide.

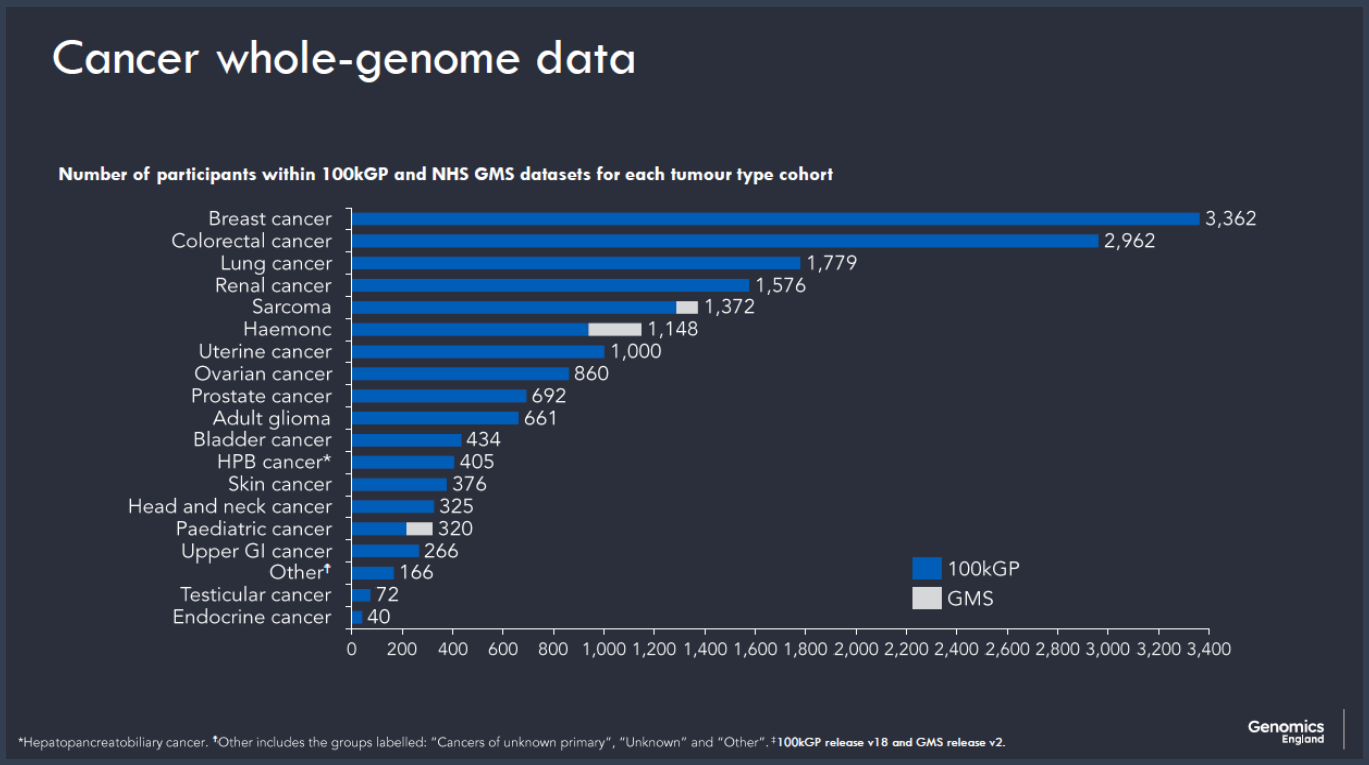


Figure 1: Cancer whole genome data from the 100,000 Genomes Project (Genomics England)

The work of the sarcoma community throughout the 100,000 Genomes Project enabled sarcoma to become a leader in this area. As a result, sarcoma is one of few cancers that has WGS routinely commissioned on the NHS in England.

Over 1,500 patients with sarcoma were recruited as part of the 100,000 Genomes Project to have their genomes sequenced.

Why is genomic testing important for patients with sarcoma?

Like all cancers, sarcoma is caused by mutations, which are changes to our genetic code, that drive the development and growth of tumours. Genomic testing for sarcoma looks at the genes in the tumour, providing personalised information on each patient's tumour.

By linking genomic data to a patient's medical records, we can begin to tease apart the biology of each individual tumour. Genomic testing can be used to help confirm a diagnosis of sarcoma and give a more accurate prognosis. It can also determine how a tumour may respond to certain drugs, which helps HCPs make personalised and informed decisions to pinpoint the right cancer treatment.

Genomic testing also creates an unprecedented dataset for research, which could be transformative for future healthcare delivery.

Who is eligible for genomic testing?

Genomic testing is not available for everyone with sarcoma. To carry out these tests, tissue samples of tumours are required, and not all sarcoma patients have samples of their tumour available (e.g., in cases where patients are not newly diagnosed). In the case of recurrence, a tumour sample may become available and genomic testing can be carried out.

What are the benefits of genomic testing for sarcoma patients?

- **Improved diagnosis** - allows doctors to confirm or adjust a patient's diagnosis, reducing the chances of a patient being misdiagnosed and receiving the incorrect treatment.
- **Understanding prognosis** - allows doctors to know how a tumour is likely to progress.
- **More targeted treatment** -can help better inform patients and healthcare professionals on which treatments are likely to be most effective and identify a patient as eligible to receive new treatments or take part in clinical trials.
- **More information about hereditary risk -** helps identify abnormalities in a patient's DNA which may offer information regarding hereditary conditions.
- **More research** - increases the data set on sarcoma patients and helps improve data for research. It helps improve understanding of genetic mutations and patterns seen in sarcoma, paving the way for future developments in diagnostics and treatment.

The Value of Whole Genome Sequencing for Diagnosis, Prognosis and Treatment

Watkins, J.A., Trotman, J., Tadross, J.A. *et al.* (2024) 'Introduction and impact of routine whole genome sequencing in the diagnosis and management of sarcoma', *British Journal of Cancer,* 131, pp. 860–869.

The study:

A recent study, published in July 2024 by the British Journal of Cancer, has demonstrated the value of WGS in the diagnosis and treatment of sarcoma, offering evidence that it can be impactful in refining diagnosis, identifying potential personalised treatment options and identifying a germline alteration.

Methodology:

The study was undertaken over two years with a cohort of 67 soft tissue sarcoma patients undergoing treatment at the Sarcoma Treatment Centre in Cambridge. The patients were offered WGS as part of their routine standard of care. Once gathered, data was interpreted by the Genomic Tumour Advisory Board (GTAB).

Results:

The use of WGS showed potential benefits for diagnosis and treatment, increasing likelihood of accurate diagnosis and access personalised treatment.

WGS led to:

A refinement in diagnosis in 37% of cases

Identification of a target for personalised therapy in 33% of cases

Identification of a germline alteration in 4% of cases

The study also highlighted that, presently, there are significant logistical challenges when looking at the expanding provision of WGS.

Conclusion:

The authors conclude that, while the rollout of WGS would pose logistical challenges, it offers significant benefits to sarcoma patients. They suggested that, in the future, WGS will become the standard investigation into suspected sarcomas.

Clinician Viewpoint: Professor Andrew Beggs

"63% of sarcoma patients who had WGS had actionable variants of potential clinical value and 33% had a germline variant."

Andrew Beggs

Professor of Cancer Genetics & Surgery in the Institute of Cancer and Genomic Sciences, University of Birmingham

A study was conducted at the West Midlands Genomics Medicine Centre which looked at the 'potential clinical utility of Whole Genome Sequencing for patients with cancer'. This project was the largest population-based genomics medicine trail with an overarching aim to introduce WGS within a publicly funded health system. Please note, this study has not yet been published in a peer reviewed academic journal.

In the study 163 sarcomas were sequenced via WGS and 33 of these samples resulted in recommendations.

Out of these 33 sarcoma samples, 21 (63%) had actionable mutations in their genome. This means that a change has been detected in the DNA that would be expected, or predicted, to affect a patient's response to certain treatments. 11 samples (33%) had a germline variant, also referred to as a hereditary variant meaning the patient has inherited a genetic variant that was present in the sperm or egg cells (germ cells) of their parents. The detection of these variants means they could identify if the patient has other potential diseases.

Why we did this project

Sarcoma is diagnosed later, is less well understood and has poorer outcomes compared to than many other cancers.

Eliminating misdiagnosis is essential for improving outcomes. The later a sarcoma is accurately diagnosed, the higher the chance of the cancer spreading to other parts of the body. Studies estimate that for every 1cm increase in the size of a soft tissue sarcoma at diagnosis, there is a 3-5% decrease in the chance of survival.

However, since the 100,000 Genomes Project and WGS being commissioned on the NHS for all sarcoma patients, genomic testing has the potential to be game-changing for sarcoma. It creates an unprecedented dataset for research and could allow HCPs to make more informed decisions about treatment and care.

Despite this, we understand that genomic testing is not being universally offered to patients with sarcoma. There is a great deal of geographical variation and other disparities leading to inequitable access to genomics for patients.

By building a picture of patients' experiences, specialist centres and hospitals' practices, as well as policies and commissioning on genomic testing across the UK, we have been able to identify some key barriers and areas for action and put forward some potential solutions which could ensure that all patients have more equitable access to genomic testing and receive the best quality care.

Project Aims

The aim of this project was to conduct a detailed scoping and mapping exercise to build a more accurate picture of sarcoma patients' access and barriers to genomic testing across the UK. This included gathering evidence about:

1. Sarcoma patients' experiences of being offered or not offered genomic testing and when they haven't, and how patients can be better supported.
2. Current policies and commissioning on genomic testing across the UK.
3. Current genomic testing and patient consenting practices in Sarcoma Specialist Centres and hospitals.

Our Approach

Patients and Family Members

Sarcoma UK approached 123 patients and families from their Patient Involvement Network (PIN). The PIN is a network of patients who have been diagnosed with sarcoma and their loved ones, who closely shape the work and priorities of Sarcoma UK to ensure the work always aligns with patients' best interests.

Patients were given the option to complete a survey or be interviewed. This enabled patients and family members to share their experiences and provide an insight into whether they were offered genomic testing during their diagnostic journey. Patients that received their sarcoma diagnosis before and after the completion of the 100,000 Genomes Project and the introduction of the National Genomics Service were included.

There was a total of 33 responses from patients (30 responses) and families (3 responses). 21 were survey respondents and 12 were interviewed.

29 patients attended Specialist Sarcoma Centres in England

1 patient attended a Specialist Sarcoma Centre in Scotland

2 patients attended a Specialist Sarcoma Centre in Wales

1 patient attended a Specialist Sarcoma Centre in Northern Ireland

Healthcare Professionals (HCPs)

Sarcoma UK contacted 46 HCPs from Sarcoma Specialist Centres (refer to page 19) and hospitals in the UK, with the options to complete a survey or be interviewed. The aim was to provide insight into the centres approach to genomic testing and what barriers may be present across different centres.
We received 15 responses from sarcoma clinicians based at centres in England. These included clinicians undertaking research in genomics. 10 were survey respondents and 5 were interviewed.

Government Departments

Health Departments from the four nations were contacted via email correspondence and asked about their current position on the provision of genomic testing for sarcoma patients, any barriers to implementation, and future priorities. We received responses from the following departments and public bodies:

- NHS England
- Genomics England
- Scottish Government Health and Social Care Directorate
- Welsh Government, Health, and Social Services Group
- All Wales Medical Genomics Service (AWGMS)
- Department of Health, Northern Ireland

33 responses from patients and families

15 responses from Sarcoma Specialist Centres and hospitals

4 responses from Government Departments

Sarcoma Patients and Families

Within this section of the report, we will cover the survey responses from sarcoma patients and their families. We will also outline the reasons patients believe they were not offered genomic testing, and what patients believe can be done to raise awareness of such testing opportunities.

Key data from survey responses and interviews

79% of patients were not offered genomic testing

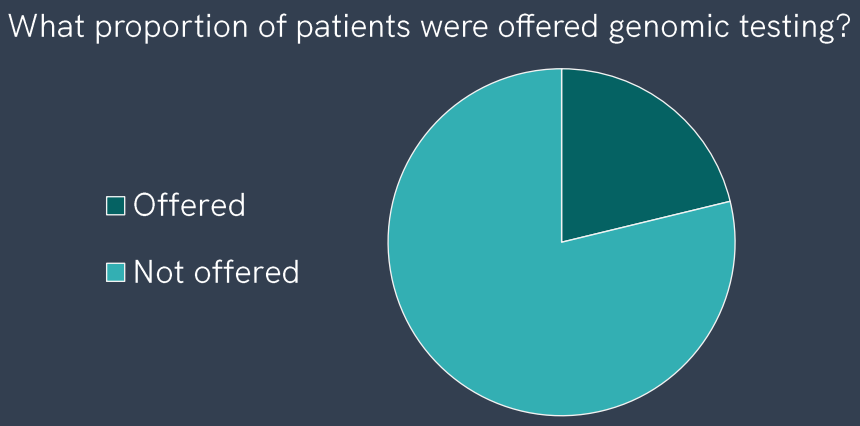


Figure 2: Number of patients offered genomic testing by healthcare professionals based on 33 responses.

Patients were asked whether they were offered genomic testing. Based on 33 responses (Figure 2), seven (21%) patients were offered testing, and twenty-six (79%) patients were not. Out of the twenty-six patients who were not offered genomic testing, two patients arranged it themselves privately and one patient, based in Cardiff, Wales, had their sample sent to Birmingham, England for testing. Out of the seven patients who were offered genomic testing, four patients were provided further information either via a letter, verbally or leaflet. However, three patients stated that they had not been provided with any further information during consultation and were not given the o

Patients who received genomic testing were diagnosed with these sarcoma types:

- Ewing sarcoma
- Pleomorphic liposarcoma
- Undifferentiated pleomorphic sarcoma
- Clear cell sarcoma
- Retroperitoneal dedifferentiated liposarcoma
- Chondrosarcoma
- Leiomyosarcoma
- Myxoid liposarcoma

For more information on subtypes see Sarcoma UK website.

Patient Story: Mike

"I was offered genomic testing after my biopsy and was given a leaflet. I discussed this with the consultant, and she explained that this could be of benefit in helping identify a link between my cancer and genome. I was also told that this would be of great value in finding future therapies for sarcoma and better ways of treatment."

Mike was diagnosed with myxoid liposarcoma in July 2023. He was offered genomic testing (WGS) at the point of receiving the results from the biopsy. He had not heard of it being used for cancer patients before.

Mike was informed of the potential benefits of genomic testing, including helping with finding future therapies and better ways of treatment for sarcoma.

"I'm shocked that it is not being routinely administered. Genomic testing should be a part of the protocol for treating sarcoma patients, since it is an emerging area with huge potential benefits. There are so many types of sarcomas, and the causes are not clear, it seems likely to me that there are genetic factors involved."

Following the discussion, he was encouraged to think about it and discuss with his wife. However, he consented straight away, and a blood sample was taken by a nurse specialist, to go with the remaining cell sample left over from his biopsy. Mike was aware of what he consented to, although on reflection he felt overwhelmed with the amount of information handed to him after his diagnosis and didn't think he was able to take it all in at the time.

After receiving his test results, Mike was informed that there were no changes in his genome that could mean that his sarcoma could be passed on to his children and grandchildren. He was also made aware of genetic changes in his tumour which may help in deciding future oncology treatments if the need should arise. In addition to this, the data from his test results will be added to a genomics database to contribute towards better and more targeted therapies for sarcoma in the future.

Reasons patients gave for why they believe they were not offered genomic testing

1. Doctors and surgeons did not see any benefits

- Some patients stated that their doctors did not think that genomic testing would be beneficial in their case and that HCPs were already confident with the pathways to treating their subtype of sarcoma.

2. Geographical barriers

- A patient based in Wales was not offered genomic testing because it was not available in their region.
- A family of a patient based in Cornwall believes they were not offered genomic testing because procedures and protocols in their region were not as advanced.

3. Timing and stage of diagnosis

- Some patients were diagnosed before genomic testing became routinely commissioned on the NHS in England.
- Others who were diagnosed during the pandemic did not receive genomic testing as many appointments and operations were postponed or cancelled.
- A patient who wasn't offered genomic testing believed that it was because their sarcoma was discovered at too late a stage for genomic testing to be beneficial.

4. Sarcoma subtype not eligible for genomic testing

- A patient stated that due to their subtype of sarcoma (skull-based chordoma) they did not have a biopsy, so believed this may have been the reason why genomic testing was not offered.

5. Process and infrastructure/systematic barriers

- A patient did not recall being offered genomic testing as the process following their diagnosis moved quickly.
- A patient was told that they would not receive genomic testing because the infrastructure/system was not established enough to process the results.

Patient Story: Janet

"I was never asked about genomic testing and nobody in my family has had any kind of cancer like it. I find it particularly interesting as I was consistently told how rare it was and was keen to find out any information about its rarity."

Janet was diagnosed with spinal osteosarcoma in 2018. She describes this as a difficult and drawn-out affair, which took three months of unbearable pain and four admissions to A&E. She was not offered genomic testing, nor knew about this type of research. She does not know why she was not offered genomic testing considering how many times she was told how rare her cancer was.

"I did ask my consultant after 13hrs of surgery if the tumour would be used for testing, and he said it was in Newcastle Uni laboratory in a jar. With this opportunity I hope my tumour is tested to help anyone else and to discover how and when it started to develop."

Janet has been left with several questions regarding her sarcoma, including whether she may have a genetic irregularity to have developed such a rare tumour at the age of 54. She would be interested in finding out the answers to her questions.

She believes that medical staff need more education about sarcoma and that information about genetics should be spoken about more in hospital, or after returning home, following a diagnosis.

Patients' suggestions on how to raise awareness about genomic testing and improve the patient experience

1. Education and information resources

Patients suggested providing educational resources on genomic testing via:

- Sarcoma UK website
- Central platforms (e.g. NHS website, Macmillan Cancer Support, Genomics England)
- Leaflets and handouts
- Medical journals
- Development of the NHS app to provide personalised guidance for patients throughout their journey – from diagnosis through to results, treatment, and what to expect post-treatment.
- Follow-up emails, letters, or phone calls after diagnosis
- Outreach activity – social media, support groups, awareness campaigns, blogs, workshops

2. Acknowledging mental health and emotional impact

Patients highlighted the importance of discussing genomic testing at an appropriate time:

- When genomic testing is discussed at the same time a sarcoma diagnosis is given, patients may not be in emotionally or psychologically ready to receive this information.
- Some patients suggested having an initial discussion about genomic testing at the point of diagnosis, with the provision of leaflets/booklets, and then an in-depth follow-up conversation a few days later, to allow them time to process information and make better-informed decisions.

3. Addressing health inequalities

Patients highlighted ways in which health inequalities should be addressed:

- Increasing accessibility to genomic testing for those located outside of central regions of England, including devolved nations.
- Having more diverse representation, such as images, in information booklets, including information on any disparities or differences in treatments for black patients and patients of ethnic minorities.

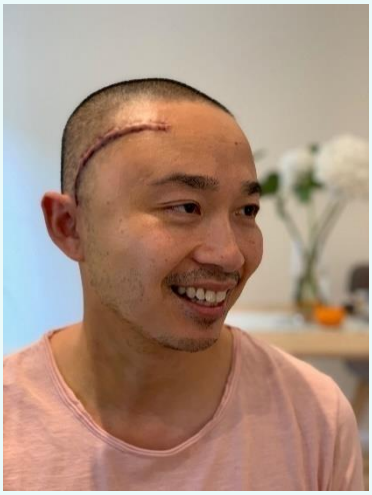
4. Improving healthcare services

Patients gave suggestions for embedding genomic testing in sarcoma provision:

- Ensuring medical staff are well informed and trained in genomics so that they can deliver information to patients in an understandable manner.
- Patients should be assigned a genomics specialist (e.g. nurse) to keep them informed throughout their journey.
- A two-stage consultation for sarcoma patients, including a discussion with nurse specialists who are well-versed in genomic testing.
- Ensuring genomic testing is part of the protocol for treating patients and having it done alongside a biopsy.
- Increasing the numbers and capacity of healthcare professionals that specialise in genomic testing.

Patient Story: David

“I felt that I didn’t have many options and had to trust the neurosurgeons. I wish I had known what decisions needed to be made and would have liked to be made aware of the different research opportunities before I began the first treatment.”



David was diagnosed with skull-based chordoma in 2020. He was not offered genomic testing and believes this was potentially because his diagnostic pathway to treat chordoma seemed clear. He also did not have a biopsy taken.

David wishes he had known key dates and decisions that needed to be made, as well as being made aware of different options for donating his tissue for further research.

He feels that it is important to have different levels of information when informing patients about genomic testing, starting with the basics, and then providing additional resources at a higher level for those who want more information. David also feels that clinical teams need to ensure that patients are engaged when presenting information.

Patient Story: Sue

"Discussing with my consultant I understand that the referral for genomics is now clearer and sarcoma oncologists have received training about the process and results."

In 2017, Sue had surgery to remove a pleomorphic liposarcoma. At that time, genomics wasn't available on the NHS. After 2 years, she was diagnosed with an inoperable recurrence. She quickly began receiving a chemotherapy drug called doxorubicin as there was a risk of the tumour blocking vital blood vessels.

"I am a doctor and was very aware that the outlook was poor, so I spoke to a friend who is an oncologist in the USA. He raised the possibility of genomic testing to see if any other treatment could be useful."

Sue investigated genomic testing and discussed the topic with her consultant. The consultant agreed it was worth doing and sent in a referral to Roche (pharmaceutical company) and organised for samples from her tumour (that had been removed two years before) to be sent off.

"The cost was around £3,000, and I was prepared to fund this myself as it wasn't something that I could access on the NHS at that time."

For administrative reasons, it took some time for Sue to get results. When the report came through it was very comprehensive and complicated, but unfortunately didn't show any new avenues for treatment. As a doctor, Sue could understand the conclusions drawn but felt it would have been useful to have been able to discuss the details with an expert. However, there had been no option to do that at that stage.

"I had always known it was a long shot and still feel it was worth doing. About two years ago it was suggested that I had another biopsy for repeat genomics to see if there were any new mutations. This would have been on the NHS."

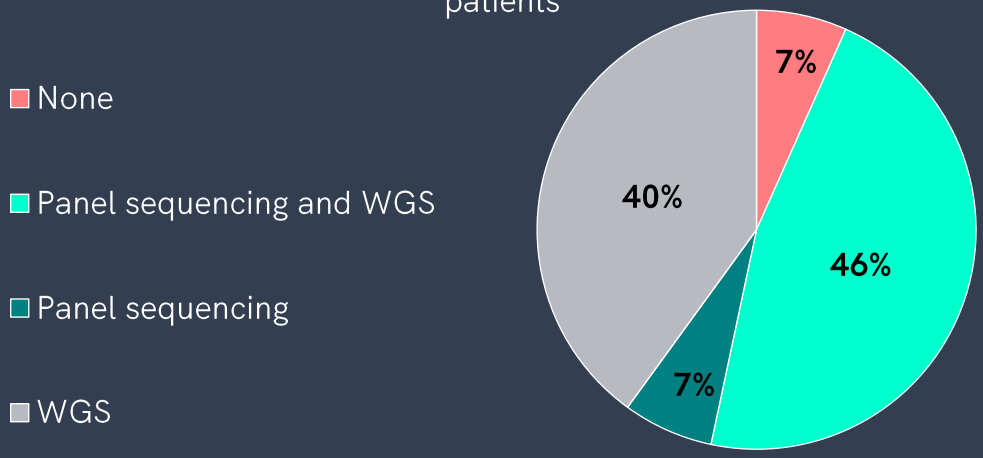
This suggestion came during the COVID-19 pandemic. Because of concerns surrounding this, Sue opted instead to have radiotherapy which has, so far, been effective in slowing tumour growth.

Sarcoma Specialist Centres and Hospitals

In this section of the report, we will cover the survey responses of Sarcoma Specialist Centres and hospitals in England, and the approach of the different centres to genomic testing. The barriers to delivering genomic testing identified by HCPs working at various specialist centres will also be outlined.

Key data from survey responses and interviews with HCPs

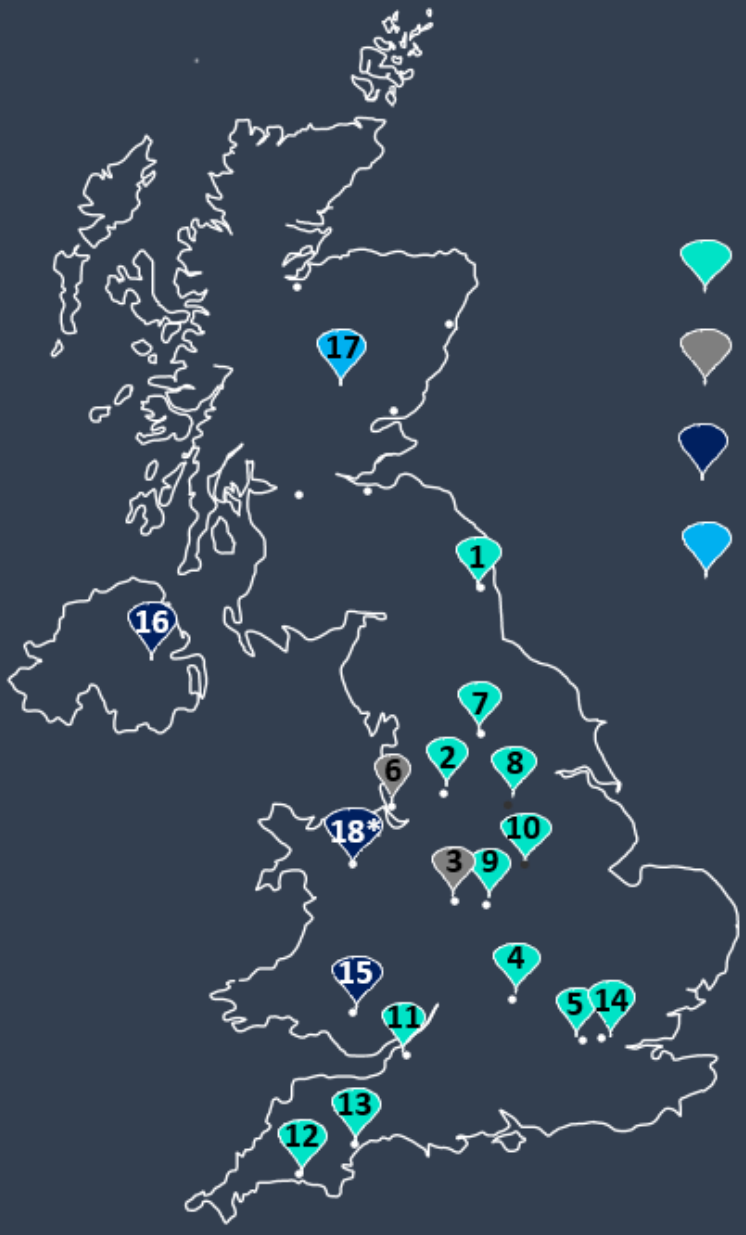
Specialist centres and hospitals in England offering genomic testing to sarcoma patients



HCPs across the UK were asked whether their specialist centre/ hospital offers genomic testing. Based on fifteen responses (Figure 3), fourteen (93%) specialist centres or hospitals stated that they do offer genomic testing, of which six centres (43%) offer only WGS, one centre (7%) offers only Panel Sequencing and seven centres (50%) offer both WGS and Panel Sequencing. One centre (7%) stated that they do not offer genomic testing as it had not been set it up in surgery yet. However, genomic is offered via their medical oncology service.

UK Sarcoma Specialist Centres offering WGS or Panel Sequencing

Based on responses from healthcare professionals and the four nations' Health Departments



Offers genomic testing

No response

Refers to NHSE

Does not offer genomic testing

England

Bone and soft tissue specialist centres:

1. North of England Bone and Soft Tissue Tumour Service, at the Newcastle Teaching Hospitals NHS Foundation Trust.

2. Greater Manchester and Oswestry Sarcoma Service (GMOSS), made up of The Robert Jones & Agnes Hunt Orthopaedic Hospital NHS Foundation Trust; Manchester University NHS Foundation Trust; The Christie NHS Foundation Trust.

3. **Birmingham Sarcoma Service**, made up of the Royal Orthopaedic Hospital NHS Foundation Trust, University Hospitals Birmingham NHS Foundation Trust and Birmingham Women's and Children's Sarcoma Service.

4. **The Oxford Sarcoma Service**, at the Oxford University Hospitals NHS Foundations Trust.

Soft tissue specialist centres:

5. The London Sarcoma Service, made up of University College London Hospitals NHS Foundation Trust and London Royal National Orthopaedic Hospital NHS Trust.

6. **Liverpool Sarcoma Service** at the Royal Liverpool and Broadgreen University Hospitals Trust

7. **Leeds Regional Sarcoma Service**, at Leeds Teaching Hospitals NHS Foundation Trust.

8. **Sheffield Specialist Sarcoma Service**, at Sheffield Teaching Hospitals NHS Foundation Trust.

9. The Midlands Abdominal & Retroperitoneal Sarcoma Unit, at the University Hospitals Birmingham NHS Foundation Trust.

10. East Midlands Sarcoma Service, at the Nottingham University Hospital NHS Trust and University Hospitals of Leicester NHS Trust.

11. Bristol Sarcoma Service, delivered by the North Bristol NHS Trust and University Hospitals Bristol and Weston NHS Foundation Trust

12.The Peninsula Soft Tissue Sarcoma Service, at Plymouth Hospitals NHS Trust

13.The Peninsula Soft Tissue Sarcoma Service, at Devon & Exeter NHS Foundation Trust.

14. The Sarcoma Unit, the Royal Marsden NHS Foundation Trust.

Wales

15. South Wales Sarcoma Multi-Disciplinary Team, delivered by Wales Cancer Network and through referral to Birmingham Sarcoma Service.

Northern Ireland

16. Sarcoma Multi-Disciplinary Team, Northern Ireland, made up of Belfast Health and Social Care Trust and South Eastern Health and Social Care Trust through the Musgrave Park Hospital Belfast, Ulster Hospital Dundonald and Belfast City Hospital.

Scotland

17. Scottish Sarcoma Network, delivered by regional centres in across Aberdeen, Dundee, Edinburgh, Glasgow, and Inverness.

[**18*. North Wales.** All sarcomas are referred to Greater Manchester and Oswestry Sarcoma Service (GMOSS).]

Sarcoma Specialist Centres and Hospitals' approach to genomic testing

Sheffield Teaching Trust, Sarcoma Adult Multidisciplinary Team Sheffield

The Sheffield Teaching Trust stated that WGS is only offered to patients who show strange morphology, relapse quickly, or have aggressive disease or disease that does not represent the standard pathology picture for malignant sarcoma patients.

Testing is offered to patients after biopsy results are given and during discussions on malignancy treatment plans with the multidisciplinary team (MDT) in case the patient requires the tumour to be removed urgently due to risk of malignancy.

WGS is not offered to GIST patients who do not have wild-type (approximately 15% of GIST patients do not have detectable mutations in a certain set of genes and are referred to as wild-type), as it is felt not to be of benefit. It is also not offered to patients whose tumour has taken a long time to relapse as the view is taken that WGS does not have utility for all sarcoma malignant sarcoma patients.

WGS was offered from January 2023 to March 2024 and is now being discontinued as the genomic nurse practitioner's post-secondment has come to an end, and the MDT feels they cannot fund the work within their workload.

However, Sheffield Children's Oncology team are increasingly offering WGS and genomic panels to all their paediatric patients.

London Sarcoma Service and The Royal Marsden Hospital

University College London Hospitals (UCLH)

At UCLH, WGS is offered as comprehensively as possible to sarcoma patients within the London Sarcoma Service. Panel testing is offered if clinically relevant, as determined by pathologists and MDT.

Patients presenting to the Royal National Orthopaedic Hospital (RNOH) will be consented before diagnosis where possible, if not then they will be consented after diagnosis. Patients who relapse without prior WGS will also be consented to re-biopsy and storage where possible.

UCLH is working hard to enable a pathway by which WGS is offered to all eligible patients but cannot routinely offer it yet. For patients who relapse in the lungs and require biopsy or resection, WGS is possible when the procedure is performed at the Royal Brompton Hospital.

The Royal Marsden

The Royal Marsden Hospital, via the Royal Marsden Clinical Genomics Service, offers an extensive repertoire of genomic testing across a variety of platforms. For sarcomas, RMH panel sequencing is performed both diagnostically and for therapeutics in specific sarcoma subtypes where there is evidence of benefit from targeted treatment. Patients are usually offered genomic testing either at diagnosis or upon the development of metastatic disease.

Plymouth Hospitals NHS Trust and Exeter Sarcoma Service, Devon and Cornwall

At the Peninsula Soft Tissue Sarcoma Service, WGS is offered to whom is it clinically appropriate at resection, and at the request of a specialist sarcoma centre. Genomic testing is offered following discussion with the MDT. Patients with high suspicion of sarcoma at the imaging stage may be offered WGS at biopsy.

WGS is not offered to patients who have been referred from other centres following resection, whereby there is no viable specimen, or where the specimens have not been stored appropriately for WGS.

Bristol Sarcoma Service, Bristol

At Bristol, WGS is offered to all patients referred to the sarcoma MDT providing that a suitable biopsy / resection specimen is available. The aim is to obtain a suitable sample at the time of biopsy, or alternatively, from the resection specimen.

WGS is offered at the time of diagnosis if a suitable sample exists, or for patients whose disease has relapsed and thus require a repeat biopsy.
NGS is performed on the diagnostic biopsy if genetic testing is required to aid diagnosis. If the patient has not had WGS or NGS testing previously, then NGS is requested at the time of disease relapse to identify any genomic variants present.

Oxford Sarcoma Service, Oxford

At Oxford University Hospital (OUH) WGS is offered to relapsed patients, patients with diagnostic uncertainty, and patients with limited options for treatment (rare sarcoma subtypes).

The stage at which genomic testing is offered depends on the patient. At OUH they try to obtain fresh tissue at diagnosis so that whole genome sequencing is an option. However, this is not always utilised. The pathway for obtaining fresh tissue is established within diagnostic pathways. If patients have diagnostic biopsies and fresh tissue is not collected, OUH offers a new biopsy for fresh tissue at the point of relapse. Panel sequencing is also offered to relapsed patients when appropriate.

Leeds Regional Sarcoma Service, Leeds

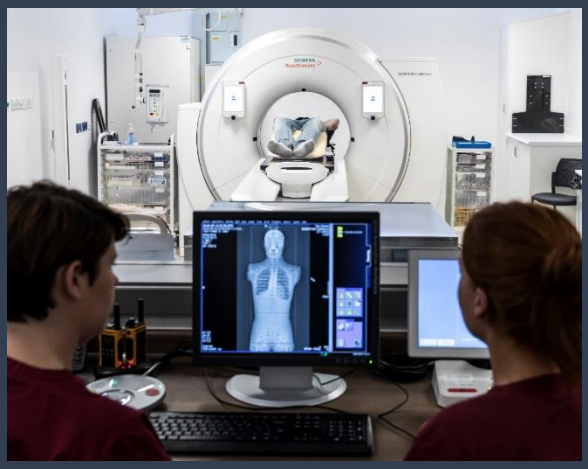
St James University Hospital does not offer WGS to patients at diagnosis based on resource and time limitations. Therefore, oncologists will select patients where they feel the results of WGS might influence how they want to treat them.

WGS is offered to patients with more advanced disease to see if they have therapeutic targets to open up new treatment avenues. WGS is also offered to patients with metastatic sarcoma, for those who have already had treatment and oncologists are looking for additional treatment to offer. WGS is also offered following a diagnosis to patients who already had chemotherapy or other treatments.

East Midlands Sarcoma Service, Nottingham

At Nottingham University Hospitals, genomic testing is routinely performed on patients' tumour samples. Currently, this is mainly in order to aid diagnosis. However, large panel next generation sequencing (RNA and DNA) is being increasingly utilised for diagnostic and treatment purposes.

All paediatric and teenage and young adult tumours are subject to large panel NGS, and WGS is now routine for these patients as well. A WGS program for adult sarcoma patients has been approved and is beginning to roll out.



Patient Story: Rob

“The first time I went into hospital I spoke to someone about the possibility of having my DNA taken as a study. However, I had my operation cancelled and I never saw this person again.”

Rob was diagnosed with dedifferentiated retroperitoneal liposarcoma in 2021. He was not offered genomic testing, although he had spoken to someone who mentioned DNA/genetic testing as an option. However, Rob’s operation was cancelled due to no available intensive care unit (ICU) beds and an under-resource of staff. Despite this, Rob stated that the treatment and care that he did receive by the staff at his hospital was superb.

Patient Story: Gerry

Gerry was diagnosed with undifferentiated pleomorphic sarcoma in 2018 and has had several recurrences since. This is Gerry's story.

"I was invited to participate in Whole Genome Sequencing when I was diagnosed with Myxofibrosarcoma. It was explained to me that Whole Genome Sequencing would identify my genome, which is a set of genes unique to me as an individual. My genes are the biological building blocks which determine my physical characteristics e.g. eye colour, hair colour and other physical attributes. **A helpful analogy is to see the genome as a 'library', and the genes as the 'books' in the library.**

"The Whole Genome Sequencing process involved taking a sample of the tumour biopsy together with a blood test. The Whole Genome Sequencing analysis of the blood sample then determined my genome and helped identify if I had a predisposition to cancer. The analysis of the tumour biopsy sample determined more precisely the specific type of tumour and helped identify the DNA mutation that caused the malignancy.

"With an understanding of my genome together with the analysis of the tumour, an oncologist could then determine whether a targeted immunotherapy drug might be effective.

"I felt encouraged and to some extent reassured when offered Whole Genome Sequencing because it meant that I would be able to benefit from any targeted drug treatments which might be suitable, and my data would help with research into the causes of sarcoma."

Barriers to genomic testing that HCPs identified

HCPs and Sarcoma Specialist Centres were asked to provide insights into existing practices or barriers that prevent more sarcoma patients from undergoing genomic testing. Based on the responses the following themes were raised as barriers to testing:

1. Turnaround time for results

Some HCPs stated that the turnaround times for processing samples can be prohibitive. One centre reported that results can take 3-6 months on average and for some patients it can be even longer. HCPs also linked these delays to the lack of staff in the Genomic Laboratory Hub (GLH) labs.

2. Resource Limitations

HCPs provided insight into various resource limitations creating barriers to the implementation of genomic testing for sarcoma patients. These include:

- Lack of training and clear guidelines on WGS and panel sequencing (including when and why to use them) for clinicians and pathologists.
- Lack of staffing and pathway coordinators to identify eligible patients and coordinate getting samples to the lab for testing. In addition, a lack of input from genomic practitioners or the clinical genetic service was reported, which leaves the responsibility of identifying eligible patients to the already busy clinical sarcoma team.
- Lack of clinic space and limited time to have discussions with patients.

3. Consenting

Genomic testing relies on clinicians to sign consent forms. However, some centres have reported challenges with getting clinicians to consent due to fear of not knowing what action should be taken on certain results, or the belief it is not their responsibility.
HCPs have also highlighted there is limited capacity of staff to assist with consenting, as many clinicians do not have the time or training in consenting patients for genomic testing.
The lack of consent forms/templates and a clear standardised process for consenting patients was also raised as a barrier.
Challenges regarding getting patients to consent to genomic testing was also raised as a barrier. It was stated that some patients may be opposed to having another biopsy, and others feared that genomic testing could result in discovery of other diseases they may be at risk of. It was also stated that in cases where a patient shows reluctance to having WGS, nurses may avoid further discussion, reducing the likelihood of patients consenting.

4. Funding

Many centres have raised issues and challenges regarding funding, particularly the lack of funding in pathology for WGS, which costs £200 per patient. It was suggested that £100,000 is needed per sarcoma centre, with a focus on improving the standard of care. Claims were made that investment is not being made in the right areas, and that the amount currently being invested is limited.

5. Lack of awareness and/or perceived benefit

It was stated that some doctors/surgeons had a lack of interest in genomic testing and did not see the benefit of testing sarcoma patients. They believed genomic testing would not change how they treat patients and saw it as irrelevant to their part of the pathway.

6. Challenges with testing procedure and recording data

Many HCPs expressed challenges with the testing procedure, including:

- Difficulties extracting DNA from the sample tumour (sometimes a consequence of a patient undergoing radiotherapy) leading to insufficient DNA on biopsy/ resection specimens.
- The need for tissue samples to be fresh and tests performed on frozen samples for WGS. Many centres are unable to do this due to a lack of facilities for storing samples and limited capacity to carry out snap-freezing procedures. Furthermore, if the sarcoma has not yet been determined following a biopsy, the labs may not hold a patient's tissue sample, making it difficult to obtain fresh samples for testing.
- Logistics in getting specimens from theatres to sarcoma pathologists that are prepared/cut up/fixed correctly. There were also challenges regarding the mechanism to request genomic tests on the systems currently in use.

7. Regulatory and policy issues

An issue was raised around the use of data by NHSE and Genomic England, regarding the provision of full legal governance and permission to pass on a patient's raw sequencing data to consultants and researchers. NHSE is not currently consenting to share these details, and a separate consent form from patients may be required for data to be downloaded and shared.

Patient Story: James and Catherine

"I wish my husband had been offered the choice to have genomic testing which could have improved his chances of finding a targeted treatment and extended his life expectancy."

Catherine's husband, James, was diagnosed with dedifferentiated liposarcoma in 2020. James was not offered genomic testing. James received a misdiagnosis from his GP and the radiographer, who misinterpreted his CT scan, which delayed a biopsy being taken. This had terrible consequences for James (he nearly died of a pulmonary embolism during his wait for results) and delayed his operation. James had chemotherapy, but this was stopped after two rounds, as his tumour kept growing at an alarming speed. When he eventually reached the point of his surgery, it became a matter of life and death.

"It was a very traumatic time for both of us and we felt we had been left in limbo for too long."

James brought up the question about DNA testing to his oncologist, but he was told that sarcoma is not hereditary so would not require DNA testing. On reflection, Catherine would have liked to know that genomic testing was available, and for the oncologist to have offered her husband the choice and explained to him how genomic testing can help to make more informed decisions about treatments, especially as her husband had a highly aggressive type of liposarcoma. Catherine commented that, currently, there aren't enough treatment options available that provide an individual, tailored approach. Catherine knows that her husband would have agreed to have genomic testing and felt that he was denied that invaluable opportunity. Sadly, James passed away in April 2022.

"I would have liked to have known that genomic testing can provide a much more accurate diagnosis than the biopsy. My husband's first biopsy was not conclusive and had to be sent to a different hospital to determine the exact subtype of liposarcoma. Waiting for the results delayed his referral to a sarcoma team which in turn delayed the start of any treatment. I feel that James deserved the chance for better treatment, and he was let down."

Catherine thinks that GPs, oncologists, and sarcoma teams should have more awareness of genomic testing and inform their patients as soon as possible. She also thinks it's important to spread the word about genomics.

Health Inequalities and Health Disparities

Health inequalities are defined as avoidable differences in health outcomes between groups and populations – such as differences in how long we live, or the age at which we get preventable diseases or health conditions.

Health disparities are defined as a particular type of health difference that is closely linked with social, economic and/or environmental disadvantage.

GOV UK, Health and Social

Hospitals and specialist centres were asked how they are addressing health inequalities, in relation to sarcoma, and equitable access to genomic testing within their local area. Some centres confirmed that genomic testing is offered to all patients and that there are no disparities regarding patients' demographics and how they are treated. However, others highlighted inequalities and disparities in their centre that need addressing.

Regional Disparities

- Inequalities between patients treated in smaller hospitals in their region, which have less access to genomic testing, and those treated in larger and more urban hospitals.
- Inequalities for patients who give consent and provide samples for testing at a different centre that the one they underwent treatment in.

Conscious/unconscious biases

- A link was made between health inequalities and biases or assumptions made by some HCPs when approaching patients. In line with wider systemic patterns, it was felt that conscious or unconscious biases may result in HCPs being reluctant to raise and discuss options such as WGS with patients from black and ethnic minority backgrounds. Therefore, they may be systematically excluded.

Lack of inclusivity of certain ethnic groups

- An issue was raised regarding certain ethnic groups being excluded due to language barriers, as well as information not being presented in a way that caters to varied cultural needs.

Solutions

HCPs suggested the following solutions to address some of these health inequalities:

- Empowering patients to ask questions and request to have genomic testing.
- Providing evidence that genomic testing works (raising awareness of academic papers and relevant research to support this).
- Training doctors on how to approach patients, including reassuring them that it's okay to not have all the answers.

Health Departments and Public Delivery Bodies across the UK

Health Departments from the four nations were contacted and asked about their current position on the provision of genomic testing for sarcoma patients, any barriers to implementation, and future priorities.

England

NHS England (NHSE)

Position on the provision of genomic testing for sarcoma patients:

The NHS Genomic Medicine Service (GMS) is currently delivered via a network of seven genomic laboratory hubs (GLHs) working together to cover all types of testing inclusive of cancer genomics.

A central feature of the NHS GMS is the National Genomic Test Directory, which sets out the genomic tests available to patients who are eligible to access a test. It also covers use of all technologies from single gene to WGS inclusive of cancer and of genomic targets that enable enrolment into clinical trials.

Barriers to the provision of genomic testing for sarcoma patients:

NHSE stated that current barriers to the implementation of genomic testing for sarcoma patients include the requirement for fresh frozen tissue and the biopsy sample being too small. However, NHSE are currently running a pilot to determine whether tissue samples can be put into fluids with preservative properties which will reduce the need for fresh tissue.

Future Initiatives:

NHSE published a Genomics Strategy in 2022 setting out ambitions for embedding genomics in the NHS over the next 5 years. The strategy sets out four priority areas:

1. **Embedding genomics across the NHS** through innovative service models from primary and community care through to specialist and tertiary care.
2. **Delivering equitable genomic testing for improved outcomes in cancer, rare, inherited and common diseases,** and in enabling precision medicine and reducing adverse drug reactions.
3. **Enabling genomics to be at the forefront of the data and digital revolution,** ensuring genomic data can be interpreted and informed by other diagnostic and clinical data.

4. **Evolving the service through cutting-edge science, research, and innovation** to ensure that patients can benefit from rapid implementation of advances.

Department of Health and Social Care (DHSC)

DHSC provided us with further information on genomics in response to a separate correspondence from Sarcoma UK (unrelated to this project) which stated:

The Government is ensuring the future of cancer care is further improved through research, such as the NHS-Galleri Trial. The trial looks for markers in blood to identify signs of more than 50 cancers. Furthermore, the Government has increased funding for cancer treatment, spending more than £8 billion across 2022/23 to 2024/25 to drive up and protect planned activity for cancer treatment.

NHS England has announced that it is providing £390 million to Cancer Alliances this year and next year to increase the capacity and prioritise the diagnosis and treatment cancer.

NHS England delivers and advises on learning and development opportunities that prepare current and future NHS professionals to make the best use of genomics in their practice.
NHS England has provided investment in education and training leads within each NHS GMS Alliance to further support raising awareness among clinicians and the public of the genomic testing available through the NHS.

The Genomics Training Academy will begin offering education and training through virtual and in-person learning for the specialist genomics workforce, including laboratory and clinical staff.[1]

Genomics England

Barriers to the provision of genomic testing for sarcoma patients:

Genomics England commented on the current barriers that may be restricting specialist centres and hospitals from providing genomic testing for patients, including the following:

- Slow turnaround times
- Barriers across the pathway for WGS due to various complexities along the journey
- Sample acquisition (germline as well as tumour)
- Administration issues regarding how tests are ordered
- Challenges with consenting
- Complexities around interpretation – how data is moved to results
- Clinicians not ordering genomic tests

Current work on addressing health inequalities:

Genomics England have developed a Diverse Data Initiative, which is a strategy to reduce health inequalities and improve patient outcomes in genomic medicine for minoritised communities.

Future Initiatives:

Genomics England are currently working on a new operating model with the aim of incorporating this into the GMS by March 2025. This will include two sites distributing sequencing capability into genomics labs, potentially leading to faster access to results and providing an opportunity to explore a different operating model for WGS.

[1] Andrew Stephenson CBE, 15 January 2024

Scotland

Scottish Government Health and Social Care Directorate

At present, genomic testing in Scotland is commissioned via NHS National Services Scotland (NSS) National Services Division (NSD) via four genomic laboratories located in Aberdeen, Dundee, Edinburgh, and Glasgow. These four laboratories work together to deliver two national genomic test directories: the Scottish Cancer Test Directory and the Scottish Rare and Inherited Disease Test Directory. These online directories detail the tests available to clinicians in Scotland as well as the referral criteria and turnaround times (TATs).

In addition to the existing genomic testing on offer, the Department published Scotland's first ever genomic strategy in April 2024. The strategy commits to working with the Scottish Cancer Network, regional cancer networks and others to identify gaps in the current cancer genomic test directory where additional tests would be of clinical value and improve patient outcomes. Any new genomic testing proposals will be considered by a Scottish Genomics Test Advisory Group (SG-TAG), overseen by the Scottish Strategic Network for Genomic Medicine for approval and adoption into the cancer test directory, subject to commissioning and funding. The proposed genomic medicine strategy has a 5-year timescale and will be supplemented by more detailed implementation plans during the strategy term.

'Currently, public finances in Scotland face an unprecedented level of challenge but we are committed to working with clinical teams to ensure that the most appropriate genomic testing is available in Scotland.' - Diagnostic, Genomics and Business Management Unit, Scottish Government

NHS Scotland

All sarcoma patients eligible for genetic testing in Scotland are offered targeted testing as part of their standard care routine diagnostic testing pathway, as detailed in the Scottish Cancer Genomics Test Directory. This testing is targeted for known genomic abnormalities associated with sarcoma and patients are therefore not consented for testing. Whole genome sequencing is not currently available to sarcoma patients in Scotland.

Future Initiatives:

The Scottish Strategic Network for Genomics Medicine (SSNGM) works across Scotland to promote the work of the network and the Genomics Laboratory Services with healthcare providers, researchers, and other organisations where appropriate. The Scottish Cancer Genomics Test Directory has been published and clear lines of communication are now in place across Scotland without regional and national cancer networks, including the Scottish Sarcoma Network.

Wales

All Wales Medical Genomics Service

Position on the provision of genomic testing for sarcoma patients:

The All Wales Medical Genomics Service (AWMGS) receive sarcoma samples from the All Wales Sarcoma Pathology group and carries out genomic testing as requested by the pathologist. The results are sent directly to the referring pathologist who integrates them into the pathology report. AWMGS is commissioned by the Welsh Health Specialised Services Committee (WHSSC)

to deliver testing for the population of Wales aligned to the NHSE Test Directory. Genomic testing (FISH) is requested at diagnosis by the pathologist to aid the diagnosis of the sarcoma. AWMGS has sequencing capability to deliver this testing in-house. However, Genomic testing (WGS or panel testing) is currently not available in Wales to aid treatment decisions.

Barriers to the provision of genomic testing for sarcoma patients:

The delay to delivery of both panel testing and WGS for sarcoma patients is due to the national shortage of clinical scientists, leading to vacant clinical scientist posts. A further barrier to the implementation of WGS in Wales is the capacity for AWMGS to receive fresh frozen sarcoma samples. The provision of fresh frozen tissue is crucial to the delivery of WGS, and this will require education and infrastructure changes in terms of samples, collection, sample processing by pathology laboratories, and a suitable transport system.

Future Initiatives:

AWMGS are in the process of establishing a somatic WGS service, and it is anticipated that this will be available for paediatric patients in Wales in early 2025 and for adult patients within the next 2 years. AWMGS is currently working with pathologists and oncologists to develop this service. Over-establishment of house training of Clinical Scientists has been ongoing for several years, and it is anticipated that the vacant posts will be filled in the next 12-18 months.

Northern Ireland

Department of Health, NI

Position on the provision of genomic testing for sarcoma patients:

In Northern Ireland, the Regional Molecular Diagnostics Service (RMDS), based in the Belfast Health and Social Care (HSC) Trust, provides germline testing and somatic testing to improve diagnosis, treatment options, and management of patients with cancer, haematological conditions, and rare genetic disorders in Northern Ireland. This includes both in-house testing and 'send-aways' of specific genomic tests to laboratories outside of Northern Ireland.

Due to the low number of sarcoma cases in Northern Ireland each year, genomic testing for Northern Ireland sarcoma patients is currently through NHS England (NHSE), where the samples are sequenced in Genomic Laboratory Hubs (GLHs) and the results returned to the requesting laboratory in Northern Ireland.

Therefore, it is the Department's position that the HSC provides for genomic testing to support diagnosis and treatment of Northern Irish sarcoma patients through NHSE.

Future Initiatives:

Repatriation of genomic testing in the future may be considered if resources allow. Work is currently ongoing to consider existing arrangements for the provision of genomic tests in Northern Ireland, benchmarked against provision by NHSE in line with its National Genomic Test Directory. The outcome of this work will inform future commissioning and funding decisions for genomic medicine testing in Northern Ireland, including the development of the genomic diagnostic service that will include testing for sarcoma patients.

In addition, work on consent and ethics in genomics is being progressed on a UK-wide basis as part of Genome UK: Shared

Commitments, led by the Office of Life Sciences (OLS) in partnership with Nuffield Council on Bioethics. A Cancer Research Strategy for NI is currently in the early stages of development but is subject to funding.

Recommendations

As a result of the responses collected in this report from patients, HCPs, Sarcoma Specialist Centres, and Governing Health Bodies, we have identified the following as key areas for action:

1. **Raise awareness of genomic testing and the benefit that it will bring to sarcoma patients.**
2. **Increase education and training for HCPs to equip the NHS workforce with the skills to deliver genomic testing.**
3. **Ensure each Sarcoma Specialist Centre has a named dedicated genomics specialist.**
4. **Increase standardisation and co-ordination of the delivery of genomic testing across the UK.**
5. **Increase funding for genomic testing to provide the necessary infrastructure to support the wider and equitable roll-out of genomic testing.**
6. **Ensure that data sharing rules are updated to protect patients' data and support data sharing.**

Recommendation 1

Raising Awareness

We need to raise awareness about genomics and its benefits for sarcoma patients. When it is clinically appropriate, genomics holds benefits for sarcoma patients including earlier diagnosis, more accurate prognosis, targeted treatment and growing the dataset for research. Therefore, it is important that patients and healthcare professionals are made aware of this.

Sarcoma UK will work with its Patient Involvement Network and healthcare professionals to **advocate for and develop resources that can increase awareness of genomic testing**. We will publish this policy report to highlight the need for change, which we will raise with policymakers in government and the NHS. We will also produce updated patient information materials for the Sarcoma UK website and leaflets about genomics, publicised through:

- Social media
- Blogs
- Support groups

Sarcoma UK call on: NHS England and Genomics England; NHS Scotland and NHS National Services Scotland; the Welsh Health Specialised Services Committee and the All Wales Medical Genomics Service; and the Department of Health, Northern Ireland to **work with the sarcoma community to further develop genomics services** and to best support patients through:

- Working with patients to develop better patient information resources
- Working with patients to share their stories
- Advertising current opportunities for patients to get involved and advocate for genomic testing such as on the NHS England NHS Involvement Hub
- Further developing the NHS app to provide personalised guidance for patients about genomic testing.

Recommendation 2

More education and training for healthcare professionals

HCPs need to be better trained to ensure the NHS workforce is fully equipped to deliver genomic testing to sarcoma patients. NHS England and Genomics England; NHS Scotland; the Welsh Health and Social Care Department, and the Department of Health, Northern Ireland should roll-out and take up education and training programmes for healthcare professionals. These programmes should deliver and support genomic testing to achieve improved outcomes in service delivery and patient care.

NHS England and Genomics England

a) NHS England has developed a Genomics Education Programme to prepare the current and future NHS workforce to make the most of genomic testing. The importance of these training courses should be highlighted, and the NHS should ensure that these resources are easily accessible to HCPs. **NHS England and Genomics England should work with Specialist Centres and Hospitals** to ensure uptake of training courses, with clear incentives supporting continued professional development. Impact should be monitored and evaluated to assess if they are leading to an increase in clinicians' understanding and improved health outcomes for patients.

b) **NHS England and Genomics England** should also work with specialist centres to co-produce new educational resources for NHS staff that cater to the needs of patients, and provide clear guidance on testing and consenting procedures to ensure that clinicians and pathologists are well-informed in this area.

c) **In the devolved nations, NHS Scotland, the Welsh Health and Social Care Department, and the Department of Health, Northern Ireland** should deliver the roll-out and take up of education and training programmes for healthcare professionals delivering and supporting genomic testing, with clear timelines and key performance indicators, to achieve improved outcomes in service delivery and patient care.

Recommendation 3

Each specialist centre should have a dedicated genomics specialist or genetic counsellor.

In order that patients to be prepared to consent to genomic testing, they need to be well-informed and supported to make educated choices whilst dealing with a suspected or confirmed sarcoma diagnosis. This requires the support of well-trained genomics specialists or counsellors working with patients in specialist sarcoma centres.

a) **The health departments in the four nations should work with specialist sarcoma centres, ensuring that each centre has a genomics specialist or counsellor to support patients.** This role will require expertise in genomics and to pass on relevant information to patients in a clear and easy to understand manner.

b) **Sarcoma UK should set up a Genomics Leads Network with Sarcoma Specialist Centres** to support learning and the sharing of best practices. The assigned Genomics Lead should take on the role of the genomics specialist for their area or region.

c) **NHS England, NHS Scotland, the Welsh Health and Social Care Department, and the Department of Health, Northern Ireland** should work with Sarcoma Specialist Centres to establish a two-stage consultation process with an initial consultation and a follow-up to support patients to make informed choices for giving consent to genomic testing.

Recommendation 4

More standardisation and coordination is needed across the UK to address health inequalities and reduce variation in access.

The four nations' health departments should work together to improve coordination on the provision of genomic testing and to standardise processes. This includes establishing a standardised UK-wide protocol for genomic testing and patient consenting, as well as measures to redress health inequalities and to ensure equitable access to genomic testing for all sarcoma patients across the UK.

a) **NHS England should consult on a national delivery plan** with clear timelines for genomic testing, to support the delivery of Whole Genome Sequencing to sarcoma patients when clinically appropriate.

b) NHS England should establish a national Genomics Tumour Advisory Board (GTAB) to encourage better coordination, planning, oversight, and delivery of genomic testing for sarcoma patients at local and national levels across England.

c) **The four nations' health departments should develop a common UK framework**, to support cross-UK coordination of genomic testing, establish a standardised UK-wide protocol for genomic testing and patient consenting, and evaluate progress on health inequalities and equitable access.

Recommendation 5

Increased funding should be made available for genomic testing to provide the necessary infrastructure to support the wider and equitable roll-out of genomic testing across the four nations of the UK.

There is a need for more funding for the NHS across the four nations to ensure that Sarcoma Specialist Centres have the resources, staffing capacity and clinic space for genomic testing to be widely available to patients across the UK.

a) **The Department of Health and Social Care and NHS England should consult with specialist centres** to undertake and publish an assessment of how to deliver the roll-out of Whole Genome Sequencing and Panel Testing and the funding and resources needed to provide for the necessary infrastructure, resources, and staffing to deliver this.

b) **Health departments in Scotland, Wales, and Northern Ireland should undertake and publish assessments of how they will expand genomic testing** for sarcoma patients, with the necessary funding and resources to provide the required infrastructure.

Recommendation 6

NHS England and Genomics England should update rules on data sharing to protect patient data and support data sharing.

There is a need to maintain strict data protection rules to safeguard patients' data. However, the evidence suggests that the current restrictions, once consent is given, are preventing the wider sharing of patient data which could support further progress by researchers and serve to deliver medium and long-term gains from genomic testing.

The four nations' health departments, working with their NHS genomic delivery bodies, should consult patients, clinicians, and local health bodies about:

- Whether the **current rules for sharing data for genomic testing** are working
- Whether **adequate data protection safeguards and support are place** in for patients consenting for their genomic data to be shared
- Whether **genomic data can be shared effectively with researchers and clinicians** to support improved health outcomes for sarcoma patients long-term.

Next steps

Sarcoma UK's plans and initiatives

1. Publish our genomics policy report to make the case to elected representatives, policy makers and NHS leadership to present evidence on what needs change.
2. Establish a Genomics Leads Network.
3. Work with clinicians to advocate for a national Genomics Tumour Advisory Board.
4. Provide accurate and engaging patient information on genomic testing.
5. Work with other charities and organisations to increase awareness about genomics and make the case for change.

Report Summary

Summary of the findings

These recommendations outline the essential steps policymakers need to take to improve the landscape of genomic testing for sarcoma patients. Together, policymakers in the NHS and Governments can deliver measurable change, maximising the number of sarcoma patients with access to genomic testing, getting specific diagnoses and targeted treatment plans earlier, ultimately improving their quality and length of life.

These recommendations require action at all levels. At a national level, they call for the NHS and representative public health bodies to invest in public awareness resources and the standardisation of genomic testing across the UK, and to address health inequalities and variations in access.

At a regional level, they need buy-in from each sarcoma centre to work towards assigning a dedicated genomics specialist and to commit to public and HCP awareness of genomic testing.

Finally, at a local level, they require primary care clinicians to be willing to learn about genomics and consider referring patients that have potential sarcomas for testing as part of their biopsy and diagnostic pathway.

At Sarcoma UK, we also know that there is more we can do to improve awareness of genomic testing, and will continue to work with patients and clinicians to empower patients to access testing. We see this report as not just as a call to action for policy makers, but as a catalyst to bring people together to ultimately improve sarcoma diagnosis and treatment and to save lives.

Closing thoughts and thanks

Sarcoma UK would like to thank everyone who helped us to create this report.

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Glossary

AHPs – Allied health professionals are the third largest clinical workforce in the NHS. Made up of 14 unique and diverse professions, their practice is integral to most clinical pathways. They work across organisational boundaries, providing solution-focused, goal-centred care to support patients' independence.

Biopsy - a medical procedure that involves taking a small sample of body tissue to be examined under a microscope.

BSG – The British Sarcoma Group is the association of the specialist clinicians, nurses and supporting professionals who treat patients with sarcoma in England, Wales, Scotland and Northern Ireland.

Gene – a unit of DNA that is transferred from parents to offspring.

Genome – the complete DNA, arranged into a set of chromosomes, in each cell of an organism.

Germline testing - testing to identify genetic variants that are present in every cell in the body inherited from the parents' sperm or egg cells (germ cells) and there since birth.

HCPs – Healthcare Professionals

Metastatic- term used to describe cancer that has spread from where it started to another part of the body.

Morphology –the characteristics of the tumour, i.e. its cell type and biologic activity.

NGS- Next Generation Sequencing is a technology used in various types of sequencing, including but not limited to panel sequencing.

Panel sequencing - the application of next generation sequencing (NGS) technology to look at variants in a specific set of genes.

Resection - surgery to remove tissue or part or all of an organ.

RNA – a single stranded molecule, chemically similar to DNA. Sequencing RNA can help to identify aberrant gene activity and identify potential treatment.

SAG – Sarcoma Advisory Groups facilitate the collaboration of providers of sarcoma services to provide optimum care based on best clinical practice.

Sarcoma Service Specification – The service specification (or the "Specification") covers the provision of care for people with sarcoma cancer, including bone sarcoma, soft tissue sarcoma and gastrointestinal stromal sarcomas (GIST), in England.

Sarcoma Specialist Centre – The centres at which all patients diagnosed with a suspected soft tissue or bone sarcoma should be referred to for final diagnosis and the management of their treatment. If diagnosed outside this centre, it should still be under their direction.

Snap freezing –the process of very quickly lowering a sample to below 70°C for preservation purposes.

Somatic testing – testing to identify genetic variants that have occurred spontaneously in specific cells.

Standard of care - term typically used to describe the existing treatment given to patients, particularly as compared to new treatment being given in a clinical trial.

WGS – Whole Genome Sequencing involves looking at the whole genome to provide more information about a patient's diagnosis or to guide decisions around treatment.

Wild type – term referring to GIST patients who do not have detectable mutations in a certain set of genes, amounting to 15% of GIST patients.

Sarcoma subtypes glossary

For more information on all types of sarcoma please visit the Sarcoma UK webpage, Types of sarcoma | Sarcoma UK, where there are free booklets and factsheets available.

Chondrosarcoma – a bone sarcoma that forms in the cartilage cells.

Clear cell sarcoma – a very rare sarcoma that can occur anywhere in the body but usually the hands or legs, around the ankles, knees and feet.

Dedifferentiated liposarcoma - liposarcoma means the sarcoma is within the fatty tissues found all over the body. It can occur anywhere but most commonly the trunk, limbs and retroperitoneum. Dedifferentiated means that the sarcoma has arisen from a similar but less aggressive tumour called well-differentiated liposarcoma (slow growing and generally does not spread to other parts of the body).

Dermatofibrosarcoma protuberans (DFSP) – a rare tumour that tends to develop from the cells in the middle layer of the skin, called the dermis.

Ewing sarcoma – a bone sarcoma that most commonly affects the pelvis, thigh bone, and skin bone.

GIST – Gastrointestinal stromal tumour is a type of sarcoma that develops in the gastrointestinal tract.

Inflammatory myofibroblastic tumour – this is a tumour that forms in tissues called mucosal surfaces. Mucosal surfaces are found in your eyes, nose, mouth, digestive tract, lungs, and genital and urinary tracts. The tumours most frequently start in the lungs but may also begin in the bladder, uterus, stomach, liver, or intestine.

Leiomyosarcoma – leiomyosarcoma develops in the smooth muscle cells.

Myxoid liposarcoma - Liposarcoma means the sarcoma is within the fatty tissues found all over the body. It can occur anywhere but most commonly the trunk, limbs and retroperitoneum. Myxoid liposarcoma is most frequently found in the limbs, particularly the thighs).

NTRK sarcomas – a type of sarcoma that occurs in the uterus and cervix.

PEComa – also known as perivascular epithelioid cell tumour, PEComa a very rare type of soft tissue sarcoma that develops from the cells lining the blood vessels. It most often occurs in the uterus, skin, liver and gut.

Pleiomorphic liposarcoma – liposarcoma develops from the fat cells found all over the body. It can occur anywhere in the body but most commonly in the trunk, limbs, and retroperitoneum. Pleiomorphic refers cells that have grown in multiple shapes and sizes.

Retroperitoneal dedifferentiated liposarcoma – a sarcoma which occurs in the retroperitoneum, which is the deep

abdomen and pelvis area. Liposarcoma within the retroperitoneum means the sarcoma is within the fatty tissues there. Dedifferentiated means that the sarcoma has arisen from a similar but less-aggressive tumour called well-differentiated liposarcoma.

Skull-based chordoma – chordoma is a type of bone sarcoma mostly commonly affecting adults in their 40's and 50's. They are typically found in the sacrum (base of the spine) and at the base of the skull.

Osteosarcoma – osteosarcoma is a type of bone sarcoma mostly diagnosed in teenagers and young adults.

STS – Soft-tissue sarcoma.

Undifferentiated pleiomorphic sarcoma (UPS) – one of the most common types of sarcoma that can occur anywhere in the body. Terms undifferentiated and pleiomorphic refer to how the cells look under a microscope. Undifferentiated means the cells don't look like the body tissue where they have developed. Pleiomorphic means the cells have grown in multiple shapes and sizes.

References

Faculty of Medicine and Health Sciences, (2023) *Transforming health care with genomics.* Available at: https://healthenews.mcgill.ca/transforming-health-care-with-genomics/

Genomics Education Programme, *What is genomics?* Available at: https://www.genomicseducation.hee.nhs.uk/education/core-concepts/what-is-genomics/

Genomics England, *100,000 Genomes Project.* Available at: https://www.genomicsengland.co.uk/initiatives/100000-genomes-project

Genomics England, *Diverse Data.* Available at: https://www.genomicsengland.co.uk/initiatives/diverse-data

Genomics England, *Transforming the Future of Healthcare.* Available at: https://files.genomicsengland.co.uk/documents/GEL-Insights-and-Welcome-Pack-2023.pdf

Lowe, A (2012) *Advances in Clinical Genomics.* AMA Journal of Ethics. Available at: https://journalofethics.ama-assn.org/article/advances-clinical-genomics/2012-08

Sarcoma UK, *Genomic testing for sarcoma.* Available at: https://sarcoma.org.uk/about-sarcoma/diagnosing-sarcoma/genomic-testing-for-sarcoma

Sarcoma UK, *Why Is genomics important in Sarcoma?* Available at: https://sarcoma.org.uk/our-research/why-is-genomics-important-in-sarcoma/

Watkins, J. et al. (2024). *Introduction and impact of routine whole genome sequencing in the diagnosis and management of sarcoma.* British Journal of Cancer.