FRANCE MÉDECINE GÉNOMIQUE 2025

aviesan

Document d'information en vue d'un examen génétique à visée diagnostique

Genetic testing for diagnostic purposes - information document

During a consultation, and in accordance with your medical history and that of your family, your doctor has prescribed the sequencing of your genome or exome.

The purpose of this information document is to explain the nature of this genetic test and its possible consequences for you and in certain scenarios for your family, by providing answers to the following questions:

This document supplements the explanations given by your doctor or genetic counsellor who remains your first point of contact should you have any questions that will help you to make your decision. If you decide to have this test, the doctor will ask you to sign a consent form.

More detailed information on this subject can be found on the French Biomedicine Agency website, www.genetique-medicale.fr.

1 What does this test involve?

A genetic test is a medical biology test. Its objective is to diagnose a genetic disease or find out, in a specific context, whether a person at risk can transmit the disease to his or her children.

The genetic test offered to you and which is described in this information document consists of sequencing (decoding) the DNA - deoxyribonucleic acid - which is found in your cells.

In the majority of cases, the analysis is performed using a blood sample. Some specific situations require another type of sample, such as saliva, skin cells, or muscle cells.

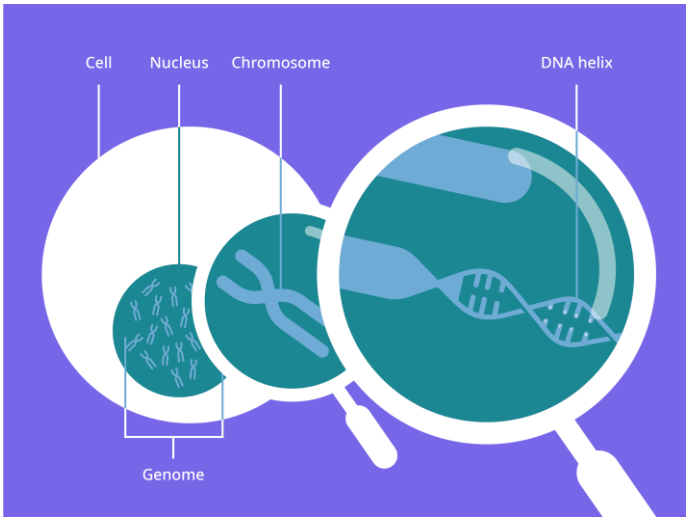
2 What do *DNA*, *gene*, *genome* and *exome* mean?

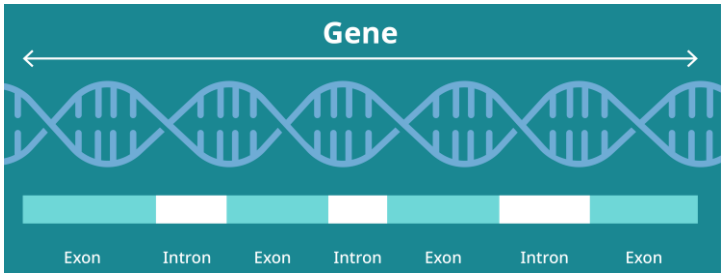
An infographic, found at the end of this document, illustrates the elements described below.

Your body is made up of billions of cells. Your genome is the complete set of your genetic material. Your genome is found in the nucleus of most of your body's cells and is unique to you. No-one else in the world has the exact same genome as you (unless you have an identical twin).

Your genome is all the DNA that makes up your chromosomes. DNA is written using four letters: A (adenine), T (thymine), G (guanine), and C (cytosine). The DNA sequence - or genetic sequence - forms a 'blueprint' containing all the information your body needs to develop and function.

Containing over 3 billion letters, your genome would fill the pages of 400 dictionaries.





A gene is a fragment of the genome. It is a specific piece of genetic information that leads to the production in the cell of a component necessary for it to function: a protein.

Around 20 000 genes have been found to code for proteins. Each protein plays a different role. For example, haemoglobin is the protein used to transport oxygen in the blood. Other proteins play a role in defining eye colour.

The genes themselves contain exons which serve as the 'construction plan' of the protein for which the gene codes. The complete set of the exons in the genome is called the exome. Although it represents less than 1% of the genome, it is the exome that contains most of the variants known to cause rare diseases. The rest of the genome is referred to as non-coding.

3 What is a genetic disease?

On average, the genomes of two people are 99% identical. The remaining 1% is where they differ and these differences are called variants. These variants, in addition to how a person interacts with his or her living environment, are responsible for the unique nature of each human being. These variants can be common or rare, ranging from the change of one single DNA letter to the addition or deletion of a chromosome.

Some genetic variants (for example, the mutation of a gene or a chromosome abnormality) can disrupt the production of proteins. These genetic variants are referred to as pathogenic.

The 'construction plan' of the protein is in some way distorted, meaning that its production is absent, excessive, or abnormal. The protein can no longer play its role correctly, which can be the cause of a genetic disease.

The generally rare nature of the pathogenic variants explains why the majority of genetic diseases are rare. The large number of genes in the genome (20 000) explains the large number of diseases (currently over 6 000 rare diseases of genetic origin).

The presence of genetic variants in your genome does not always lead to a disease; some variants may go completely unnoticed or only express themselves according to your living environment. The presence of such a mutation is associated with an increased risk of developing a disease.

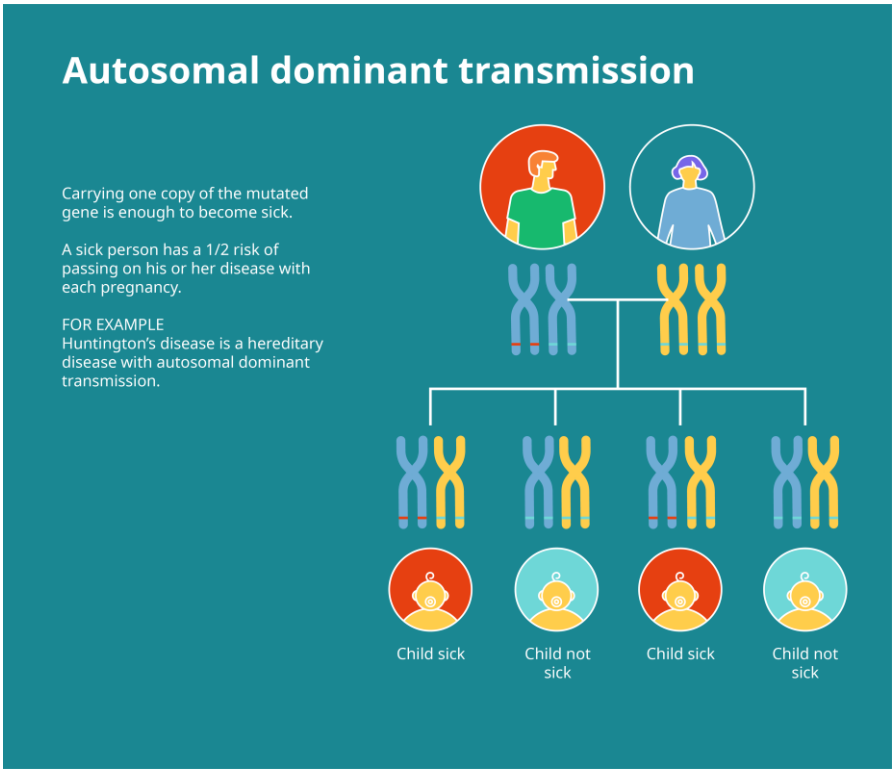
The disease can manifest at different ages.

4 How does a genetic disease develop?

With a few exceptions, genes are present in an individual in the form of two copies, called alleles. These copies generally differ: one allele is derived from the egg and the other from the sperm. A pathogenic genetic variant can be passed down from one generation to the next and/or be present in several family members of the same generation. The corresponding diseases are hereditary diseases.

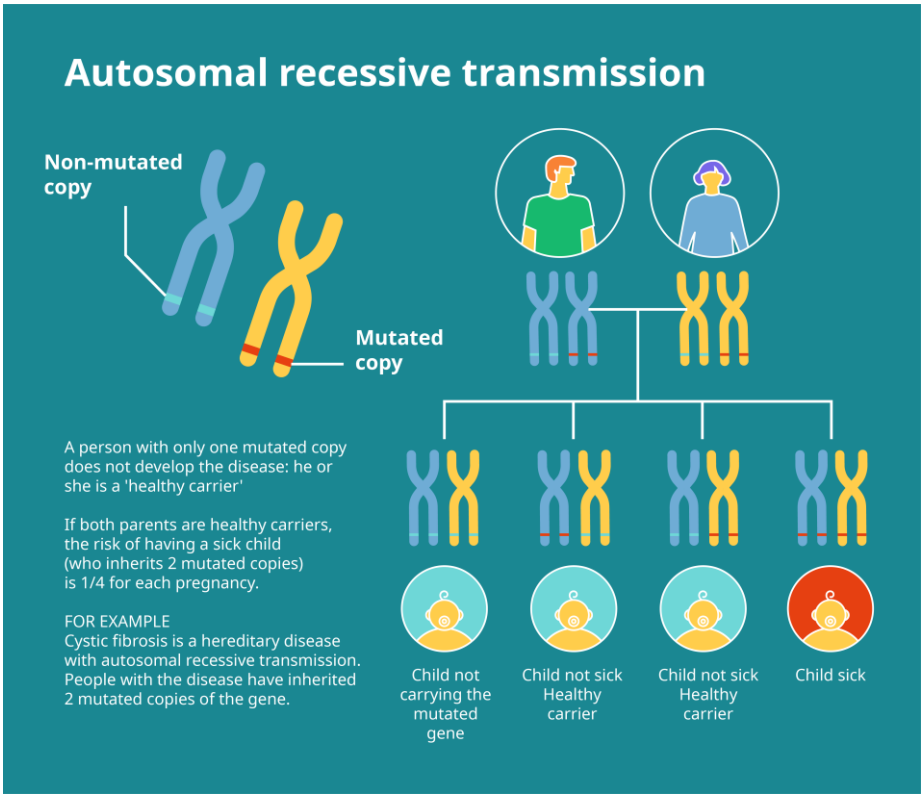
The mode of transmission of the disease differs according to the genetic mechanism.

There are two principal modes of transmission:



- One copy (allele), which is the cause of the disease and inherited from one of the parents, is sufficient for the disease to develop. This is known as dominant transmission.

- One copy (allele), which is the cause of the disease, must be inherited from both parents for the disease to develop. This is called recessive transmission.



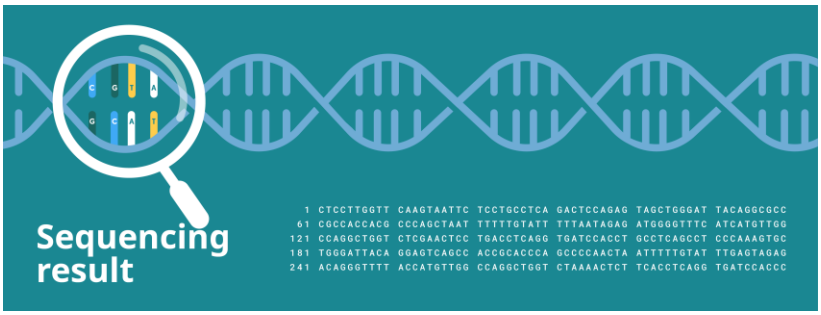
The genetic variant causing the disease can occur accidentally during the production of the gametes (sperm, egg), or very soon after fertilisation. In this case, the person born from these gametes or as a result of this fertilisation may carry the genetic abnormality in all of his or her cells (including the reproductive cells) and the disease may affect any offspring.

Your doctor or genetic counsellor will explain the mode of transmission that concerns you.

5 What do *genome sequencing* and *exome sequencing* mean?

The genetic test offered to you consists of reading your DNA: this is known as sequencing. It may look at all the exons (whole exome) or all the DNA (whole genome). The objective is to detect the genetic variants that could explain your disease.

The result of the sequencing is presented as a succession of the four letters that constitute the DNA molecule: A T G and C (see section 2).



Although it is now possible to read a whole exome or a whole genome, interpreting the readings remains difficult and restricted to current knowledge. The vast quantities of data produced by these new technologies are analysed using powerful computerised tools combined with the expertise of bioinformaticians, genetic technologists and clinical geneticists. Given the large number of variants in each individual, the challenge with a genetic disease is to identify the variant responsible for that disease, which is like looking for a needle in a haystack. To make this interpretation easier, it is often necessary to study the DNA of the parents and more rarely that of the other members of the family.

6 What are the possible results of a genetic test?

A genetic test can produce three types of result:

1. It identifies one or more genetic (pathogenic) variants (commonly referred to as mutations), which could explain your disease.

2. It identifies one or more genetic variants but their impact on your health is uncertain. In this case, it may be useful to supplement your analysis with other genetic tests, or even have other members of your family undergo them – which requires their consent.

3. It is unable at the present time to identify any modification that might explain your disease.

In this situation, if you agree, the data generated by the test will be stored and may be reused as part of the same diagnostic approach, depending on advances in knowledge. In which case, your clinical geneticist will inform you.

In all cases, your doctor will inform you of the results. Your doctor or genetic counsellor will explain the results to guide you in the next stages of your medical care.

7 Must I inform my family? If so, how?

If you are found to be the carrier of a genetic abnormality, then other members of your family may also be carriers.

The genetic heritage passed down from the parents is to some extent shared by different members of the same family (brother, sister, cousin, uncle, aunt, etc.).

If there is the risk of serious consequences for which preventive measures or treatment exist, the law requires that family members be informed of the genetic abnormality.

They then have the option to consult a clinical geneticist who will advise them on the appropriateness of a genetic test. If required, their medical care will be adjusted based on the results of the test.

It is the role of the prescribing doctor or genetic counsellor to define who, within the family, is or is not at risk of carrying a familial genetic abnormality. The genetic abnormality and degree of kinship are taken into account when evaluating this risk.

Who informs the family? Which family members?

If you have been diagnosed with a hereditary genetic abnormality that may be the cause of a serious condition (whether or not related to the reason for your consultation), for which preventive measures exist, including care and genetic counselling, you can inform your affected family members directly. If you do not wish to do this, you can ask the doctor to inform them for you.

You can request this when signing the consent form.

If you choose to inform them yourself, your doctor or genetic counsellor can assist you, for example with the help of a document explaining the disease and how it is inherited. Psychologist support is also available, if required. Finally, the contact details of patient associations may be useful for you so that you can discuss things with them and get the benefit of their experience. Your doctor can advise you.

If you ask your doctor to inform your family members, he or she will send a letter advising them to make an appointment for a genetic consultation. Neither you nor the diagnosis of your disease will be mentioned.

Although this solution helps some families, it is not the most appropriate. Family communication is preferable.

If you refuse to inform your family members yourself or if you refuse to have the doctor inform them for you, your civil liability may be incurred.

The family members concerned, having been unable to make arrangements for appropriate care, may seek compensation for the harm suffered.

It is also envisaged that:

- You can ask not to be informed of your own test results and to have the doctor inform the other members of your family (this can be requested when signing the consent form).
- You can ask for this information to be sent anonymously.
- If you have donated your gametes (eggs or sperm), the doctor, with your authorisation, will inform the fertility clinic (which has allocated your gametes to one or more infertile couples), so that it can take the necessary measures for any children born as a result of this donation.

8 How might the biological samples and data from this test be used?

Biological samples

Thanks to advances in sequencing techniques, the amount of biological material (number of cells) required to perform the test is becoming increasingly small. It may be that some of the sample collected (for example, blood) is still available for use.

You can accept or oppose this storage on the consent form.

If you accept, the law envisages that this sample may be used:

- *Either* as part of the same healthcare approach (use of a different technique, confirmation of the results): in which case you will not be asked to sign a new consent form.
- *Or* for research purposes. This research may directly concern the disease for which you have sought medical advice, or another genetic disease, or another research subject. In this case, the researcher is obliged to inform you of his or her research and check that you do not oppose the use of your samples in it.

Data

Likewise, the data resulting from the genetic test (the sequence of your exome or your genome) are sensitive data subject to specific legislation:

- If the analysis of your sequence does not provide any information on your disease, the data will be stored for reanalysis as and when new information becomes known about the genes potentially implicated in the disease.

You will not be asked to sign a new consent form.

- As with the biological samples, the data resulting from the sequencing may help to further knowledge through research, particularly on genetics.

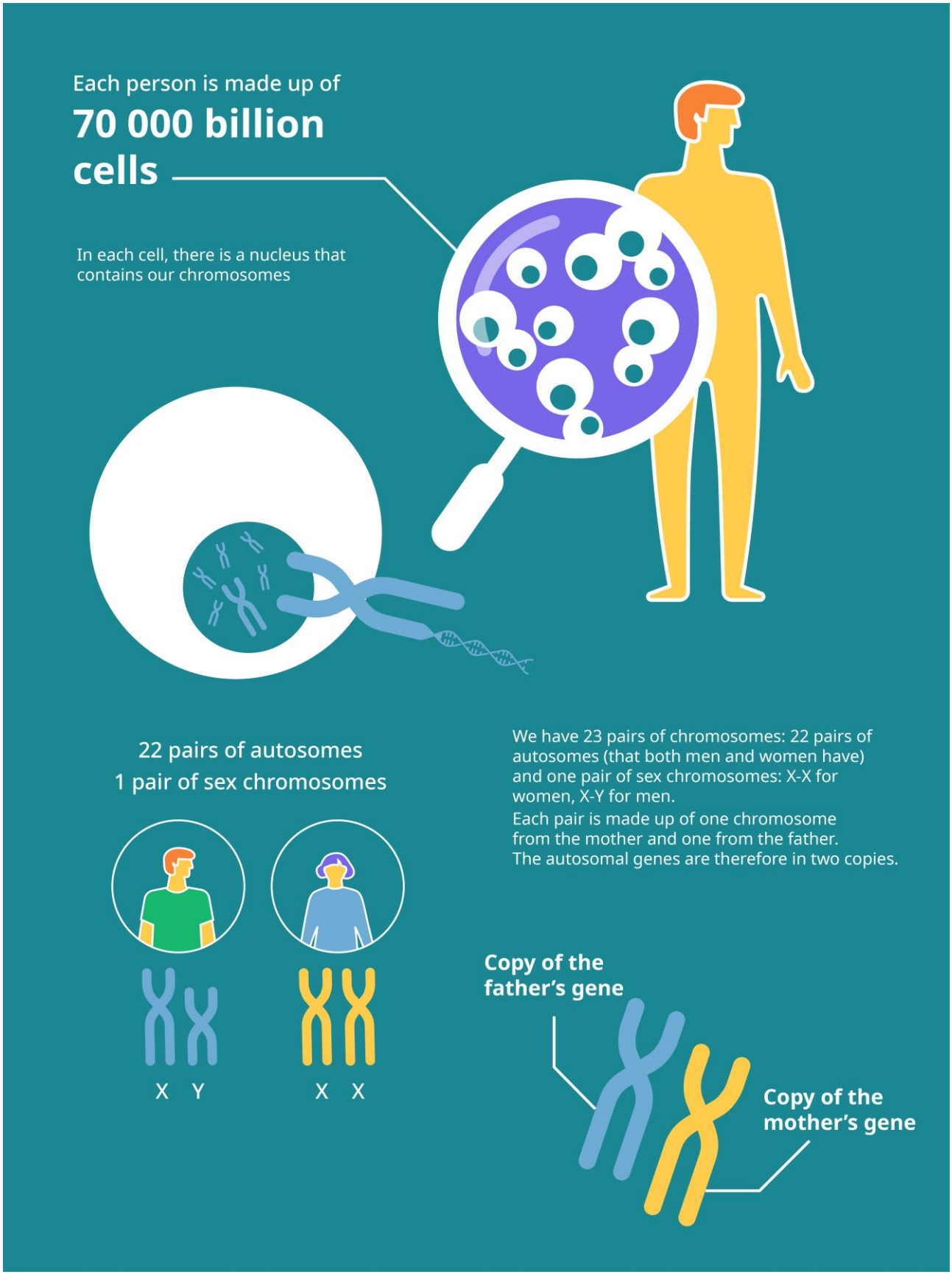
If you accept the principle of this, your data may be communicated to other research teams, private or public, national or international, within the framework of research that is authorised in advance, with the appropriate safeguards to ensure confidentiality that are set out in a data-sharing contract/agreement between Inserm and the data recipient(s).

You can, freely and at any time, without affecting your medical care, oppose the subsequent use of your data in research by contacting your doctor.

The 2025 French Genomic Medicine Initiative website (https://pfmg2025.aviesan.fr/en/projets-de-recherche/) contains all the necessary information that is specific to these projects. You have the right to obtain a copy of the documents relating to the transfer of your data and you will be informed of the purpose of any new processing of that data at the relevant time on the website (https://pfmg2025.aviesan.fr/en/projets-de-recherche/).

Reminder of your rights

- Freedom to choose
- **Right to be informed:** if you have difficulty understanding the information that has been given to you verbally or in writing and if you have any questions, please do not hesitate to ask them. The medical teams are there to answer them.
- **Right to access your personal data:** you have the right to access and rectify your data.
- **Right to oppose the transmission of your data:** you have the right to oppose the transmission of your data (including your genetic data and ethnic origins) which are covered by the obligation of professional secrecy and may be used and processed as part of research programmes. These rights can be exercised by contacting your doctor/geneticist who is the only one to know your identity.
- **Right to erase data:** you have the right, except in a limited number of cases, to request the deletion of your personal data. However, please note that any useful data collected before you exercise your right to oppose or withdraw your consent may continue to be processed in a confidential manner so as to meet a legal obligation and not compromise the fulfilment of the research objectives.
- **Right to restrict processing:** you have the right to request that the use of some of your data be temporarily frozen. The objective is to avoid the dissemination of information that needs to be verified by temporarily suspending its processing throughout the time needed to perform those verifications.
- **Right to data pseudonymisation and confidentiality:** your identity is protected. Your name will never be disclosed. The rule of medical secrecy applies to all of your data.
- **Right to your health information:** with your agreement, you will be informed of any information relating to your health.
- **Right to change your mind at any time:** without having to give a reason, regarding the use of your biological samples for research purposes by contacting your doctor/geneticist.


Each person is made up of
70 000 billion cells
In each cell, there is a nucleus that contains our chromosomes
22 pairs of autosomes
1 pair of sex chromosomes
X Y
X X
We have 23 pairs of chromosomes: 22 pairs of autosomes (that both men and women have) and one pair of sex chromosomes: X-X for women, X-Y for men.
Each pair is made up of one chromosome from the mother and one from the father.
The autosomal genes are therefore in two copies.
Copy of the father's gene
Copy of the mother's gene

Our 23 chromosome pairs are made up of DNA: this filament in the form of a double helix carries the genes.
A gene is therefore a fraction of the DNA.

DNA is comprised of 4 chemical elements that form the code of our genetic heritage. This code is made up of the following 4 elements: A (adenine), T (thymine), C (cytosine), G (guanine).

A T G C

On this DNA, and therefore in our chromosomes, are our genes: these form our genetic heritage, which is unique to each of us and is passed down from our parents.
It is the instruction manual for our whole body.
It dictates how it works and what it looks like.

The human species has around **25 000 genes:** this is the genome.

The genes specify the role of each of our body's cells. Based on the information they contain, they synthesise proteins that are essential for life: this is the translation of the genetic code. We produce dozens of different proteins. The functioning of our body depends on these proteins.

When a gene or chromosome is modified or deleted: the proteins concerned are produced incorrectly or they are not produced at all.

myosin

For example, myosin is a protein that is used for muscle contraction.

When myosin is incorrectly produced because of a mutated gene, the person develops a genetic disease called a myopathy that causes the muscles to not work properly.

When the body's instruction manual (chromosome or DNA) contains errors that lead to poor protein synthesis and therefore dysfunctions, this is a hereditary genetic disease.

2025 French Genomic Medicine Initiative

Consent to the medical genetic testing of an adult[1]

Patient IDENTITY (label or last name, first name, and date of birth)

I, the undersigned, acknowledge that I have been informed by:
☐ Dr…… (Tel. / / / /)
☐ Genetic counsellor …….…….. (Tel. / / / /) under the responsibility of Dr…….. (Tel. / / / /)

About the genetic testing that I have been offered

For the diagnostic testing of (the name of the disease or group of diseases tested for or the indication of the prescribed test must be specified):

I have received information that particularly concerns:

- The disease being tested for, the means of detecting it, the level of reliability of the tests, the possibilities in terms of prevention and treatment, as well as the risks of genetic transmission of the disease, the possible impacts on members of my family, the necessity to inform them and how they can be informed.
- The storage and possible future use of my biological samples and the data generated by the test.

I have also been informed of the potential continuation of this initiative, so that I can benefit from changes in current knowledge. If this is the case, I will be regularly informed of its continuation and findings within the context of my follow-up.

The doctor or genetic counsellor has given me an information document that includes the aforementioned elements and he or she has answered all my questions.

I hereby consent to the prescribed test[2].

I have been informed that I can revoke the choices below at any time, without this affecting my care.

I wish to be informed of the result of the testing performed[3]	Yes ☐ No ☐

I authorise the storage of unused biological samples and data generated by the test for possible future use as part of the same diagnostic approach, in accordance with changes in knowledge.	Yes ☐ No ☐

[1] Protected adults, in accordance with article 459, paragraph 1 of the French Civil Code, may give their own consent, where their condition permits. If informed consent cannot be given alone:

- the legally-protected adult makes his or her decisions assisted by the person in charge of his or her protection;
- if informed consent cannot be expressed with the aforementioned assistance, the adult is represented by a guardian, appointed by a guardianship judge, who receives all the information and who can consent.

[2] Article 16-10 of the French Civil Code
[3] Article L. 1111-2 of the French Public Health Code (CSP)

Notification of family members

If I have donated my gametes (or embryos) in the past, and if the diagnosis is confirmed, I authorise the doctor to notify the fertility clinic concerned so that it can inform anyone born as a result of this donation[4].	Not concerned ☐ Yes ☐ No ☐

If the diagnosis is confirmed, I will inform all or some of the members of my family who are potentially concerned, from the moment that prevention and care measures, including genetic counselling, can be offered.	Yes ☐ No ☐
For the members of my family who I do not inform, I will ask the doctor to inform them on my behalf, respecting medical confidentiality.	Yes ☐ No ☐

If my response to the two previous sections is 'no', I have been informed that I could be held liable.

This information is covered by the obligation of professional secrecy and the right to privacy under the conditions of article L1111-4 of the French Public Health Code.

In accordance with data protection provisions, I have the right to access and rectify my personal data and to object to the processing of said data, through the intermediary of Dr……

Place	**Date**
Patient last name, first name, and signature (mandatory)	

[4] Article L. 1131-1-2 of the French Public Health Code (CSP)

CONFIRMATION OF INFORMATION PROVISION [5]

(By the prescribing doctor or genetic counsellor)

Patient IDENTITY (label or last name, first name, and date of birth)	

I hereby certify that the aforenamed patient has been informed of the characteristics of the disease being tested for, the means of detecting it, the level of reliability of the tests, the possibilities in terms of prevention and treatment, the modes of genetic transmission of the disease, the possible impacts of the test results on family members, and how said family members can be notified.
I certify having obtained the patient's consent under the conditions laid down by law.

Date:

Signature and stamp of the doctor or genetic counsellor:

[5] Protected adults, in accordance with article 459, paragraph 1 of the French Civil Code, may give their own consent, where their condition permits. If informed consent cannot be given alone:

- the legally-protected adult makes his or her decisions assisted by the person in charge of his or her protection;
- if informed consent cannot be expressed with the aforementioned assistance, the adult is represented by a guardian, appointed by a guardianship judge, who receives all the information and who can consent.

Consent to the storage, for possible research, of the samples and data generated by the genetic testing of an adult for medical purposes

I have also received information on the possible future use for research purposes of my biological samples that are not used in the diagnostic approach, as well as data generated by the test.

If my biological samples or my genetic data are used, I will be informed of the intended research project or data processing operation and will have the possibility to object to it[6].

I have been informed that I can revoke the choices below at any time, without this affecting my care.

I authorise the storage of the biological samples that are not used in the diagnostic approach for possible future use in research.	Yes ☐ No ☐
I authorise the storage of the data obtained from the diagnostic approach for possible future use in research.	Yes ☐ No ☐

In accordance with data protection provisions, I have the right to access and rectify my personal data and to object to the processing of said data, through the intermediary of Dr……

Place	**Date**
Patient last name, first name, and signature (mandatory)	

[6] On the right of information and the right to object:
- Article L. 1131-1-1 of the French Public Health Code (CSP) on biological samples
- Articles 48, 56 and 75 of French law no. 78-17 of 6 January 1978 and articles 14 and 21 of the General Data Protection Regulation (GDPR) 2016/679 regarding health data

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