NOVOGENIA

Network of genetic laboratories

What makes us special

The advantages of Novogenia

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Advantages of the Novogenia laboratory and services

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Table of contents

Competitive comparison

What types of genetic laboratories are there?

Type 1) Diagnostic medical laboratories
Type 2) Paternity testing or animal genetic testing laboratories
Type 3) Direct-to-consumer genetic testing providers
Type 4) Preventive and Lifestyle genetic testing laboratory

Novogenia as a laboratory

1. Novogenia does not perform internet sales
2. Novogenia runs its own laboratory
3. Novogenia keeps up to date with the cutting edge of technology
4. The advantages of the Novogenia analysis technology
5. Novogenia has very low recall rates
6. Reports that are understandable
7. Continuous improvement of analysis reports
8. Action plans, not diagnosis
9. Add on products – Manufactured by the Novogenia group
10. Highest level of quality control
11. Novogenia adheres to the highest scientific transparency standards
12. Criteria for choosing the right genes to analyse

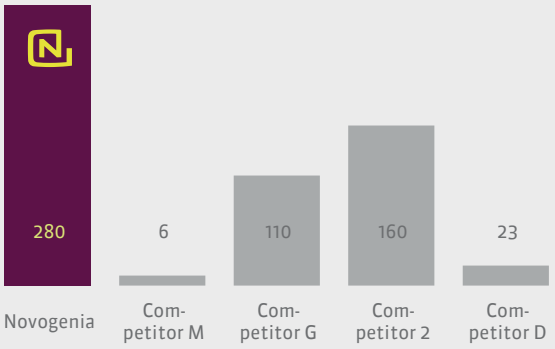
Competitive comparison

This is how we compare to our main international competitors:

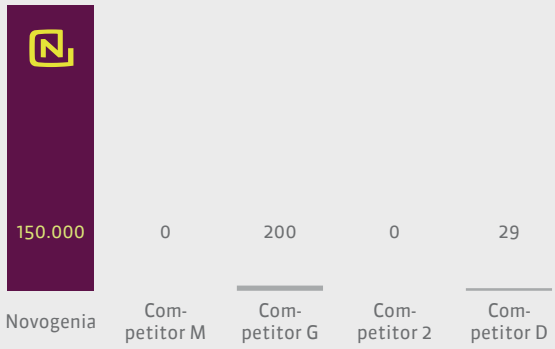
Number of available Lifestyle and prevention programs

Number of total products available

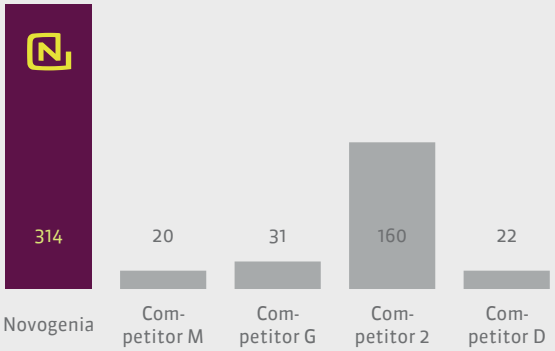
Number of Genetic variations with proven effect tested



Number of foods evaluated



Number of Pages of largest report



Age of company

Capacities

	Novogenia	Com-petitor M	Com-petitor G	Com-petitor 2	Com-petitor D
Own Laboratory	✓	X	X	X	X
Medically licensed	✓	X	X	X	X
Allergy Testing	✓	X	X	X	X
Blood testing	✓	X	X	X	X
Metabolic testing	✓	X	X	X	X
Genetic testing	✓	✓	✓	✓	✓
Animal Genetics	✓	X	X	X	X
Newborn screening	✓	X	X	X	X
Online sales competing with Distributors	X	X	✓	✓	✓
Micronutrient Manufacture Capabilities	✓	X	X	X	X
Cosmetics manufacture capabilities	soon	X	X	X	X
Personalized Recipe book	✓	✓	X	X	X
Online menu planning portal	✓	✓	X	X	X
Gene results openly communicated	✓	X	✓	✓	✓
White labelling	✓	X	X	X	X
Lab Certification	IISO15189, ISO 9001, Austrian Medical Genetics License	NONE	NONE	CLIA	NONE

What types of genetic laboratories are there?

While there are currently around 1500 medical genetic laboratories worldwide, only few specialize in genetic prevention and nutrigenetic/lifestyle genetic testing. To give a better understanding of the field of genetic testing, I want to give a more detailed description of the different types of laboratories and services.

Type 1) Diagnostic medical laboratories

This type of laboratory is by far the most common type. They typically choose anywhere between one and 500 different genes to analyse. The diseases that are caused by errors in these genes are typically very severe for the person's health and in most cases no preventive advice or treatment options exist.

Most of these genetic diseases are very rare and affect fewer than one in 500 individuals, more often fewer than one in several hundred thousand individuals. In many cases the results can be a death sentence whereby the genetic test merely helped in diagnosing the cause of the problems. Due to the serious nature of these genetic diseases, the regulatory status for laboratories in this category is very strict to uphold a high standard in quality control. The reports are typically very technical and brief, as they are meant for a medical genetic specialist.

A typical result may be:

The patient is heterozygous for the risk allele of the single nucleotide polymorphism rs12345. This type of results gives a clinical geneticist sufficient information to then interpret the results, but is typically incomprehensible for patients who rely solely on the correct interpretation of the clinical specialist.

Type 2) Paternity testing or animal genetic testing laboratories

As these types of analyses have no medical impact on human health, they tend to fall outside the regulatory framework of most genetic testing laws.

As a consequence, laboratories are usually allowed to work at far lower quality control levels than medical laboratories do. The results might be a percentage likelihood of paternity or sometimes a typically very technical report about genetic errors in an animals genome.

Typ 3) Direct-to-consumer genetic testing providers

This type of company typically focuses more on prevention as well as nutrigenetic and lifestyle genetic testing.

The aim is to provide genetic testing services directly to and customers without the involvement of a trained specialist or clinician. As a consequence, these types of reports tend to be more suitable for non-specialists as the language tries to avoid complicated technical terms.

Novogenia as a laboratory

While Novogenia puts its main focus in the laboratory group type 4 (preventive and lifestyle testing laboratory), it also operates in the areas of type I and type II genetic testing laboratories. During the course of this document, however, I want to focus on the essential differences between competitors of Novogenia that belonged to the type III and type IV category of laboratories.

1. Novogenia does not perform internet sales

Internet sales of genetic testing is a new emerging market. Nonmedical genetic tests such as weight management or ancestry genetic testing are typically available over the Internet and pose little risk to the individuals in case there would be misinformed. As such, these types of genetic tests may very well be offered over the Internet and at least to my knowledge, there is no legal restriction for the distribution of nonmedical lifestyle genetic tests without the aid of a clinician or trained specialist.

When the direct-to-consumer genetic tests cover disease risks, however, the legal framework of many countries begins to take effect. In the countries of Austria, Germany and Switzerland, medical genetic tests are prohibited unless a clinician counsels the patient and requests the genetic test at the laboratory. As such, direct-to-consumer genetic testing over the Internet focusing on medical genetic tests is by law prohibited in the countries Austria, Germany and Switzerland. Most other European countries do not have such restricting laws and there it is legal to offer medical genetic tests in this form. European law does, however, permit to export such genetic testing services for medical use if the country it is performed in does not have such a restriction on the request of a medical genetic test.

As such, medical genetic tests over the Internet are also available in the countries that prohibit such a test by law. This has given some direct-to-consumer genetic testing providers a bad reputation. An additional problem with Internet genetic testing sales is the conflicts this creates with the company's distributors. Should direct-to-consumer genetic testing company X offer its services through a distributor who acquires a customer, the distributor is likely to lose the customer through company X website store, where the customer can buy the genetic test sometimes for an even lower fee. As such, Internet sales as well as sales through distributors often causes a lot of conflict for the distributor.

Novogenia is a purely non-Internet sales company that works exclusively through distributors and does not serve individual customers. If individual customers contact novogenia, they are referred to the closest distributor in the customer's vicinity.

2. Novogenia runs its own laboratory

Most direct-to-consumer companies as well as lifestyle and prevention laboratories keep the costs low by outsourcing their laboratory work to some commercial medical laboratory or university laboratory. While this makes business a lot easier for these types of laboratories, it has a number of significant disadvantages.

In many cases, outsourcing laboratories after requirements but they will only perform an analysis if for example 50 or 96 samples are sent at the same time. This can often cause very long waiting times for the first sample, as they have to wait for the whole batch of samples to be collected before analysis occurs. In some cases this can lead to a waiting time of up to 10 weeks before a sample is analysed.

Furthermore, if the analysis is outsourced, the company has very little control over quality control. During our history we have also collected some experience with outsourcing laboratories and even though some of them had very good credentials, error rates of their analyses were sometimes in acceptably high.

In addition, the focus of a supplier laboratory may shift, causing lapses in service quality or maybe even the decision to discontinue supplying the company with genetic testing services. This can often cause critical disruptions in services which is uncomfortable for the distributor and end customer.

Furthermore, outsourcing genetic testing services to a laboratory usually limits your in the choice of technology, as you are restricted to the technology the outsourcing laboratory uses, which may not always be the best choice.

As a consequence, Novogenia decided to set up and maintain its own very high end medical genetic laboratory. This laboratory has been optimized and set up exclusively for these types of genetic tests and so no other laboratory projects interfere with the performance or quality of genetic tests being performed.

3. Novogenia keeps up to date with the cutting edge of technology

Novogenia set up its laboratory in 2009 and use the most advanced equipment in the high resolution melt analysis technological field. The capacity was 100 different genetic tests to be performed in a 2 hour cycle.

In 2011, the capacity and technology have been surpassed and Novogenia discontinued its by then already old analysis technology and upgraded to fluorescent probe hybridization capable of performing 384 different genetic tests per two hour cycle. In addition, the technology became fully automated, thereby capable of working 24 hours per day and seven days per week. This improved turnaround times and the ability to test more genes per customer.

In 2015, technology has improved even further and Novogenia began its transition to an even more powerful analysis technology. The microfluidic's driven analysis platform now allows 9000 different genetic tests to be performed in a two hour cycle. While these transitions to new technologies is very expensive and labor-intensive, novogenia strives to always stay at the cutting edge of technology in genetic testing.

2009: High resolution melt analysis Technology

- **100 genetic tests per 2h cycle**
- **Capacity: 8000 genetic tests per month**

2011: Fluorescent probe Hybridization Technologye

- **384 genetic tests per 2h cycle**
- **Fully automated 24/7 operation**
- **Capacity: 138 000 genetic tests per month**

2015: Microfluidics Technology

- **9000 genetic tests per 2h cycle**
- **Capacity: 720 000 genetic tests per month**

Background information:

A genetic test means that one genetic variation is measured in one gene and in one individual. Many genetic testing programs require several genes to be tested, which must be considered when evaluating the capacity.

4. The advantages of the Novogenia analysis technology

There are a number of technologies, which can be used to test for genetic variations:

Sanger Sequencing:

This technology is very old but still considered one of the gold standards of genetic testing. With this technology a string of genetic letters is read out of the person's genome in a quite complicated and expensive reaction. The results are displayed as curves, which need human interpretation to get the right result. Nevertheless, error rates as high as 20% have been reported for this technology. Due to the very complicated procedure and expensive reagents, this type of analysis is not a good match for genetic variation measurements.

Agarose gel restriction fragment length polymorphism:

This also very old technology can be used to cut small amplified genetic fragments. If the fragment cuts, a certain genetic mutation is present. If the fragments cannot be cuts, no genetic mutation is present. Limitation of performing at most 20 samples at once as well as the long processing time involved and the labor-intensive procedure does not make this a good match for genetic variation measurements.

DNA micro arrays:

in principle, this is a very powerful technology, which has originally been invented for research purposes. It allows the laboratory to measure up to 1 million genetic variations of one person and these genetic variations are typically interspersed at equal distances throughout the person's genome. While this number may sound very impressive, in reality usually only a few hundred of these have any medical or lifestyle significance. Most of them simply exist and have no effect on the body and are therefore of no medical or lifestyle relevance. The reason, why so many genetic variations are tested with this system are at, because these DNA micro arrays can be used for research. Researchers can for example take 1000 diabetic patients and 1000 healthy individuals and compare each one of the 1 million genetic variations between the two groups. In many cases they then find that one genetic variation in a previously unidentified location is more common in diabetics than it is in healthy people. This allows the conclusion, that at this position there must be a diabetes associated gene, which can then be further investigated. In other words, this technology has great research benefits for the company using it. The disadvantage of this technology is, that it does not allow you to test all of the genetic variations you would like to test. Approximately 30% of the genetic variations that are important for a person's health can not be analyzed and are usually missing from such DNA micro arrays. This causes the problem, that when a person uses such a technology to for example determine his or her risk for a certain disease, where 10 genetic variations are involved, the information gathered will only cover about seven of these 10 important genetic variations. This gives an incomplete picture of the disease risk and may lead customers to draw the wrong conclusions. When we compare our portfolio to the most powerful DNA micro arrays available

on the market, we find that we would miss at least 30% of all of the important genetic variations. With about 99% accuracy, this technology is relatively accurate when compared to older technologies. In many cases, however, the results of individual genetic variations are not clear enough, which causes unfortunate gaps in the final report.

Fluorescent probe hybridization:

This very robust technology has become the new gold standard in genetic variation analysis. The laboratory has to choose the genetic variations it wishes to analyze and then a genetic reagent setup (called assay) must be developed for every single genetic variation. This takes significantly more time than for example using DNA micro arrays, but it gives the laboratory the flexibility to choose all of the important genetic variations for a disease. The disadvantage is, that the reagent use becomes quite significant (and thereby the cost increases) if several dozen or even several hundred genetic variations are being analyzed per person. Novogenia's second expansion of technology used fluorescent probe hybridization until the number of genes to be tested simply became the limit.

Microfluidics:

Microfluidic's is essentially the miniaturization of normal genetic testing reactions using the fluorescent probe hybridization technology. If the amount of reagents previously needed to test one genetic variation in one person, it is now possible to test several hundred genetic variations in the same time. Very small channels are used to press the reagents and the samples into less than 10 nL small chambers, where the reaction takes place. The technology promises a 99% accuracy, but we have observed accuracies higher than 99.97% in our laboratory. The flexibility and robustness of this technology simply make it one of the most powerful technologies currently available for genetic variation analysis.

5. Novogenia has very low recall rates

Saliva swabs are an inherently difficult sample material, as they are dependent on the right collection procedure to supply a good sample. Due to this difficulty, most genetic laboratories have a recall rate of about one in 30, meaning that every 30th customer would have to send in another sample. Novogenia has put a lot of effort into optimizing this process and has managed to establish an impressive recall rate of one in 150. This is done through a number of specific tweaks:

For one, we use saliva swabs that dry within the tube. Drying them outside the tube with risk for mix-up or the possibility for fungus to grow inside the tube if drying was not complete, can be avoided in this case.

Secondly, we use three saliva swabs than just one collection system. This allows us to have three attempts of DNA extraction in case the DNA quality is bad.

Finally, we analyse every swab up to three times, adding up to nine full analysis attempts before we have to request another sample.

6. Reports that are understandable

Most laboratories issue reports with heavy technical terms, making them unsuitable for end customers and untrained medical professionals. Novogenia puts much emphasis on creating understandable reports and routinely tests them on nonmedical individuals to ensure efficient and correct communication.

7. Continuous improvement of analysis reports

At the time of writing this (2015), our reports are currently at version 387. This means, that since the first reports were created, they have been modified and improved 387 times.

Customer feedback is taken seriously and if there are ways of improving the reports and communication to improve the user experience, this is integrated into the reports. Many competitors products have not changed since the first creation as these companies often focus on marketing rather than keeping the products at the newest state of science.

Since Novogenia exclusively works through local redistributing partners, it can put all of its energy into creating newer and better genetic testing products rather than having to invest time and energy into marketing campaigns.

8. Action plans, not diagnosis

Direct-to-consumer genetic testing companies as well as new prevention and lifestyle genetic testing companies tend to have a very strong focus on the question: “what genetic risk do I carry in my genes?”, which I like to describe as diagnostic focus. Back in 2009 when Novogenia started, we also were very heavily focused on diagnoses of risks or genetic traits. For example, our weight management product back then consisted of six genetic variations (we have eight now) and gave the customer information such as: you are sensitive to carbohydrates and insensitive to fat, so try to reduce your carbohydrates and increase your fat intake to lose weight.

Most customers found this very interesting, but not many of them managed to use this information to change the lifestyle and lose weight. When you look at competitors products I see the same typical beginner mistakes in many of them. They focus all too much on the information encoded with the genes and much too little on how to use his information to a person’s benefit. It took us much experience and years of developments to continuously improve the program to produce great and consistent weight loss results with the program. Today, only about the first five pages are actually about diagnosis and the remaining 200 pages focus on how to use this information effectively. Customers need guidance of how to change your diet, guidance of how to create a personalized exercise program, guidance on how to track the results and additional tools such as a personalized recipe book. All these things took years to develop and improve and this is probably the point where the difference between Novogenia and his competitors is greatest.

9. Add on products – Manufactured by the Novogenia group

While genetic testing and the encoded information is a very powerful tool, this is not where the possibilities end. It is possible to create personalized products such as supplements or recipe books based on an individual’s genetic makeup to help with making use of the genetic information. Most genetic testing companies don’t venture into this area and the few that do, outsource them to manufacturers who were typically not set up to produce products on a small scale such as one vitamin mixture for just one person. The typical result is, that the manufacturer produces maybe five different vitamin mixtures and the laboratory then tries to choose the best match for a person, rather than producing the supplement specifically for the person’s needs. As it was impossible for Novogenia to find a supplier who could produce the level of personalization in supplements, Novogenia decided to take supplement production into its own hands. Today, Novogenia purchases vitamin raw materials from high-end suppliers and produces the micro transporters in its own facilities and packages every vitamin mixture based on every customer’s unique genetic profile. As an example: with over 700 trillion potential genetic outcomes, virtually no customer will get the same product as another customer. This is the level at which personalization of products should be.

10. Highest level of quality control

The genetic laboratory of Novogenia is located in Austria. In this country, it is necessary to have the government certification for medical genetic testing which is quite difficult to obtain and maintain.

Novogenia also opted for the optional iso-15189 certification for medical laboratories to ensure its high standard of quality. To improve quality control and speed up process and in the laboratory, quality control was largely automated for software that Novogenia's software developers created specifically for this purpose.

We are routinely audited by the Austrian government, iso-quality control auditors as well as professional auditors hired by our customers. The recurring opinion of our auditors is, that we tend to surpass the requirements in all fields and we have received the highest scores, some of our auditors have ever given to a company or laboratory.

11. Novogenia adheres to the highest scientific transparency standards

All of science works under the principle, that you have to reference the source of any scientific claim that you make and that you need to give independent scientists the opportunity to check your work for errors. This ensures, that even if a genetic testing laboratory happens to make a mistake in interpretation of genetic results, that these errors or incorrect claims are discovered and corrected.

Many genetic testing companies decided to keep their signs and procedures a secret. In many cases you are not informed of what genetic variations are being tested, how this information is used to create the (weight management) program and what science has been used to create this product. While these companies claim, that this is the way that they protect their intellectual property, it is often no way to hide an inherent lack of scientific approach in the development of this program and to hide the fact, that some or all of the claims being made might have no scientific basis at all.

Novogenia follows the highest level of scientific transparency. All of the studies used for our products are listed in the reference section and we put great effort into communicating the genetic variations we are analysing, the genetic result of the person being analysed and the interpretation conclusions to be drawn from these results. Independent critics or scientists will always have the opportunity to check our results and our interpretation for errors. This openness about our approach makes up vulnerable to external parties checking our claims, but it ensures the highest level of scientific validity and prevents us from making claims that are simply scientific but not true.

12. Criteria for choosing the right genes to analyse

Every year, we get around 160,000 new scientific papers in the field of life science, many of them focusing on genetics. We also very often get new discoveries that a mutation in a certain gene appears to be a risk factor for a certain disease. In many cases, these first scientific discoveries cannot be replicated by other scientists in other populations, making it likely that these first initial claims have been incorrect. As a consequence, very strict selection criteria must be applied to genetic studies to make sure that the genetic claims being made are in fact scientifically correct and valid.

Here are the criteria which have to be met for Novogenia to integrate a genetic test in its prevention of lifestyle programs:

1. Are there sufficient numbers of scientific studies on this genetic variation?

Having one scientific study performed by one genetic scientist on one population is never enough to say that this is scientifically proven. The minimum criteria in medical sciences is to have at least three well-designed and large genetic studies having been performed by at least three different scientists (to prevent the same scientists making the same mistake in other studies) and to be performed on three different populations (to prevent a coincidence in the population studied to cause a wrong result). Only if the same risk of disease can be seen in every one of those populations performed by every one of those scientists, do we know that it is scientifically valid to assume that this genetic variation is a risk factor for a certain disease.

2. Does the genetic variation have a significant impact on the disease risk?

In some cases, a genetic variation might increase your disease risk by 1%. If this disease is also very rare, for example only one in 1000 people suffers from it, this one percent increase in risk is insignificant for the person's health. As a consequence, Novogenia only chooses genetic variations, that have a significant impact on a person's risk of disease to warrant having this genetic variation tested.

3. Is the genetic variation, and enough to warrant testing?

Some genetic variations are very, very rare. Congenital fructose intolerance, for example, occurs only in one in 50,000 individuals. As a consequence it would take 50,000 people to be tested for one person to gain a benefit from this genetic test. This kind of genetic tests might be useful in rare clinical settings, but for a prevention service this genetic test would not be relevant, even though it might be a test that could be sold very well with correct marketing.