

# GENE TECHNOLOGY IN MEDICINE DEVELOPMENT AND PRODUCTION

A responsible approach



# GLOBAL BIOETHICAL STANDARDS

Ethical issues have no borders. Novo Nordisk therefore strives for global standards and has global requirements for its business partners and suppliers. Novo Nordisk actively supports regulation which guides how the industry uses new science and technologies to develop innovative pharmaceutical treatments. Novo Nordisk also engages directly with relevant stakeholders to keep abreast of emerging issues in bioethics and reconcile dilemmas as they arise. The commitment to operate in a respectful manner and to continuously raise the ethical bar is stated in our bioethics policy.

# NOVO NORDISK'S BIOETHICS POLICY

In Novo Nordisk we will discover, develop and produce biological medicines with respect for people, animals and the environment. This means that we will:

- continuously improve our performance
- promote bioethical awareness in Novo Nordisk
- operate by high ethical global standards in research involving people, animals, human material and gene technology
- require adherence to high ethical standards by our external partners, contract research organisations and suppliers, and monitor their performance
- engage in stakeholder dialogue and partnerships helping us to deal with ethical dilemmas
- comply with laws, relevant requirements and act in accordance with international conventions.



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# MADS KROGSGAARD THOMSEN

Executive vice president and chief science officer, Novo Nordisk

In research, gene technology offers opportunities for identification of new treatment concepts for patients. In production, it provides substantial benefits to product quality and the environment.

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# OUR APPROACH TO GENE TECHNOLOGY IN MEDICINE DEVELOPMENT

Gene technology provides exciting opportunities to discover and produce new treatments for a variety of medical conditions. Novo Nordisk is a pioneer in this technology and we are committed to engineering proteins into safe and effective therapies. For nearly a century, we have been refining our protein competencies. We have established world-class expertise in protein engineering as well as protein expression in cell cultures.

Today, the genetically engineered cell cultures are the only feasible way to produce our biological medicines and an absolute requirement in the production of large quantities of high quality products.

## From pig glands to yeast cells

In 1923, in the beginning of Novo Nordisk's history, insulin was extracted from the pancreatic glands of pigs and cattle. To provide patients with insulin identical to the natural human one, we converted the extracted pig insulin into human insulin in 1982. By means of gene technology, we were able to shift from gland extraction to production of human insulin in yeast cells in 1987. Without gene technology more than 1,000 million pig glands would be needed a year to meet the demand for diabetes treatment worldwide today.

#### Backbone of R&D

Since 1987, gene technology has been the backbone of our research and production. We have invented and marketed several new insulin products – insulin variants – where the natural human insulin molecule has been modified to provide people with diabetes with improved treatment options. Furthermore, we have developed new yeast strains producing greater quantities of insulin, which has also helped us substantially reduce consumption of water, energy and raw materials. Gene technology is likewise used within Novo Nordisk's other therapeutic areas – haemophilia, growth disorders and obesity. Gene technology evolves at a remarkable pace, and we believe that ethical review and risk assessment are needed to assess each intended purpose of using gene technology – it must be ethically sound, sustainable and safe. Our use of gene technology for research and production is based on 25 years of risk assessments and safety records. No damage to human health or the environment has ever been recorded due to the use of gene technology, while millions of people have been treated for serious diseases.

We believe that the benefit of using gene technology to develop and offer treatments for serious medical conditions by far outweighs any potential risks.

Nevertheless, we have a precautionary approach and continuously aim at eliminating and reducing any uncertainties. Novo Nordisk actively participates in debates and responds to the concerns of society through dialogue and open communication.

# OUR POSITION ON GENE TECHNOLOGY

To ensure uniform ethical standards globally, Novo Nordisk has developed a position statement on its use of gene technology

- Novo Nordisk finds that the contained use of gene technology is an important tool in the identification, development, and production of pharmaceuticals for patients. These pharmaceuticals could not otherwise be provided in sufficient quantity or quality.
- Novo Nordisk actively participates in the development of relevant international standards for gene technology.

- Novo Nordisk uses production strains without antibiotic resistance genes whenever technically possible and practically feasible.
- Novo Nordisk recognises the concern about accidental release of GMOs to the environment and has implemented appropriate measures to ensure compliance with regulations set by the authorities.
- Novo Nordisk supports the proper regulation of the use of gene technology and the principle that public concerns are adequately addressed.
- Novo Nordisk applies the Precautionary Principle in the use of gene technology by conducting risk assessments prior to use.
- Novo Nordisk only uses GMOs in the lowest risk category for production and the final products do not contain genetically modified cells or genes.
- Novo Nordisk supports transparency and openness in relation to the use of gene technology and continues to report publicly on our use of the technology.

# USE OF GENE TECHNOLOGY AT NOVO NORDISK



# **BIOLOGICAL MEDICINES**

Gene technology in research and production of biological medicines

Gene technology is used to discover and produce new medicines. Some medicines are based on proteins, which can only be produced in living cells. Therefore the pharmaceutical industry uses cell cultures as production organisms. These production cells have been genetically modified by the insertion of genes which enable the cells to produce the desired protein.

## Use of gene technology

Novo Nordisk uses gene technology in both research and production of biological medicines.

In research, genetically modified cell cultures are used to gain as much understanding as possible about how a potential new medicine works before it is tested first in living animals and later in humans. Cell cultures are also used to screen for indications of unwanted effects, to minimise the risk to animals and humans. The application of gene technology enables Novo Nordisk to produce a variety of biologically active proteins – various types of hormones for the treatment of diabetes, obesity and growth disorders as well as blood clotting factors for the treatment of haemophilia.

All Novo Nordisk's biological medicines are derived from production cells, specifically yeast, bacteria and mammalian cells. These cells often produce protein precursors that need to undergo a small chemical alteration to obtain fully functional pharmaceutical proteins. Novo Nordisk's extensive purification processes ensure that none of our products contain genetically modified cells or genetic material.

### **Recombinant proteins and variants**

The term gene technology covers various techniques that enable genetic material to be modified. For example, the DNA of an ordinary baker's yeast cell can be altered, resulting in yeast cells producing copies of the naturally occurring human glucagon protein. This protein (recombinant protein) can then be used as a pharmaceutical in diabetes treatment.

Gene technology can also be used to alter naturally occurring proteins, resulting in novel pharmaceutical proteins that differ in some respects from natural ones. For example, to improve diabetes treatment, the insulin protein has been engineered (modified) into insulin variants with improved properties. The use of these modern insulins provides people with diabetes with the option of tighter disease control by better mimicking a healthy body's secretion of insulin, which is continuously regulated as a response to changes in blood glucose levels.

SUDE IGDIR Turkey Sude has Type 1 diabetes

# THE POTENTIAL OF GENE TECHNOLOGY

Novo Nordisk's biological medicines provide millions of people with treatment for serious diseases. We believe that gene technology has the potential for further development of novel treatments for a range of medical conditions with an overall positive impact on human health and quality of life.

# USING CELLS TO PRODUCE MEDICINES

The role of DNA and proteins

Some human diseases, including diabetes and several growth disorders, are caused by a deficiency of specific active proteins. By means of gene technology, the naturally occurring proteins like insulin and growth hormone can be produced and used as medicine to treat these diseases. The application of gene technology in the discovery and production of biological medicines is based on knowledge of the normal function of the cells, including the role of DNA and genes in the production of proteins.

### **DNA and proteins**

The cells of all living organisms contain hereditary material in the form of DNA put together in two long strands that form the well-known double helix shape. The DNA is a long strand of genes, encoding for all the necessary proteins. A gene codes for the creation of one protein.

Proteins are essential for the functioning of the body. They constitute essential building blocks in tissue such as muscles, and are involved in al-

most all bodily processes. Some examples of the body's proteins are the oxygen-binding component of blood, hormones like insulin, digestive enzymes and enzymes that catalyse chemical reactions in the body, e.g. the blood clotting factors. Complex functions like the immune system are also dependent on a multitude of proteins.

### From genes to medicines

Knowledge about genes and proteins is applied in gene technology. A gene coding for the construction of the insulin protein, for instance, can be isolated from a human cell.

A gene sequence containing an insulin protein precursor code can subsequently be synthesised in a laboratory and inserted into the DNA or plasmid of a specific production cell, such as baker's yeast, which allows it to be 'read' by the cell. When the inserted gene is read, it will automatically instruct the cell to produce the insulin protein precursor. The expressed protein precursor can then be chemically altered and purified, and

## GENES

A gene is defined as a stretch of DNA that contains the information to produce one protein. Proteins are important for all processes in the body, e.g. the insulin protein is important for regulation of blood sugar.

the resulting insulin – which is identical to human insulin in its amino acid composition – can subsequently be used to treat diabetes.

With the technique described above, living genetically modified production cells will be able to produce precursors or copies of naturally occurring complex proteins. This is called recombinant protein expression. All of Novo Nordisk's biological medicines are proteins made by recombinant protein expression: the hormones insulin, GLP-1 and glucagon, which are used to treat



diabetes; GLP-1, at a higher dose, is also used to treat obesity in many countries; blood clotting factors, which are used for treating haemophilia; and human growth hormone, which is used for growth disorders.

# Using antibiotic resistance genes to select the modified cells

Research laboratories around the world often use antibiotic resistance genes as a marker in

the genetic engineering process. This enables isolation of those cells that have successfully been genetically modified, as they will be the only cells to survive in the presence of the specific antibiotic. It has been a cause of concern that an accidental release of such cells could potentially lead to the transfer of resistance genes into disease-producing bacteria. Because antibiotics are used to treat infections, it is important not to increase the level of antibiotic resistance among microorganisms in the environment. Over the years, studies and control measures have shown that Novo Nordisk's production using microorganisms with antibiotic resistance marker genes does not contribute to the spread of antibiotic resistance. Even so, Novo Nordisk has decided that whenever practically feasible, all strains of production cells will be developed without antibiotic resistance marker genes as a precautionary approach.

# DISCOVERING NEW MEDICINES

Application of gene technology in research

# Modifying naturally occurring proteins for treatment

In some cases it is beneficial to use gene technology to create a modified version of a naturally occurring protein. One example is Novo Nordisk's modification of the insulin molecule, resulting in both slow- and fast-acting variants called modern insulins which provide patients with improved options to mimic natural blood sugar regulation.

Another example is the modification of a gut hormone, a small protein called Glucagon-Like-Peptide-1 (GLP-1). Novo Nordisk investigated whether this protein could be used as a treatment for type 2 diabetes, but found that the naturally occurring protein is degraded in less than two minutes after injection into the bloodstream, rendering it unsuitable as a pharmaceutical. However, by the insertion of a modified GLP-1 gene into yeast cells and a subsequent chemical modification of the GLP-1 analogue produced, a protein variant has been created that remains in the bloodstream long enough to obtain the clinical benefit with an injection only once daily. The modified GLP-1 has been approved for treatment of type 2 diabetes and also approved at a higher dose for obesity in many countries.

# Therapeutic antibodies to treat haemophilia and diabetes

Novo Nordisk also applies gene technology for research in therapeutic antibodies for the treatment of haemophilia and diabetes. Therapeutic antibodies primarily work by inhibiting interaction between specific proteins involved in the processes causing these diseases. Due to the complex composition of the antibody proteins, they may only be produced in genetically modified mammalian cell cultures.

## Laboratory cell cultures

Novo Nordisk studies the effects of new medicines on human and non-human living cells growing in the laboratory in cell culture. Gene technology is often used to change how these cells behave or to allow scientists to better understand how the new medicine affects the behaviour of the cells. Additional genes or gene fragments may thus be inserted into the living cells to genetically modify them. This helps Novo Nordisk to better predict the clinical effect and side effects of new medicines.

## **Transgenic animals**

Gene technology is applied in the development of transgenic animals, such as mice. Transgenic animals are animals whose hereditary properties have been permanently modified by the introduction of recombinant DNA into their germ cells.

For example, the genes of animals can be modified to mimic diseases in humans, e.g. diabetes or haemophilia. Novo Nordisk uses animal models including transgenic animals. This enables us to generate helpful information about a disease and predictive information about the effect and safety of a new pharmaceutical product prior to testing in people. Animal research carried out by Novo Nordisk cannot be initiated before an approval has been granted by external authorities as well as by our internal Ethics Review Council.

You can find more information describing Novo Nordisk's approach to animal research in the brochure *Animals in pharmaceutical research and development*.

## Gene markers assist stem cell research

To improve studies of the natural cell development process from stem cells to insulin-producing beta cells, human and animal stem cells are genetically modified by adding marker genes, which can easily be traced. Finding a cure for diabetes is part of Novo Nordisk's vision and recent progress in stem cell research has raised hopes for a future cure by cell replacement therapy. There are important ethical issues related to the use of stem cells which are carefully addressed by Novo Nordisk. You can read more about Novo Nordisk's use of and position on stem cells at novonordisk.com.

# PROTEINS MANUFACTURED USING GENE TECHNOLOGY

Selection of recombinant proteins

| THERAPEUTIC AREA       | GENERIC NAME   | RECOMBINANT PROTEIN  |
|------------------------|--|--|
| Diabetes               | Insulin  | Recombinant human insulin  |
|                        | Insulin detemir  | Recombinant long-acting insulin derivative   |
|                        | Insulin aspart   | Recombinant fast-acting insulin analogue   |
|                        | Insulin degludec   | Recombinant long-acting insulin derivative   |
|                        | Liraglutide  | Recombinant glucagon-like peptide-1<br>(GLP-1) derivative  |
|                        | Glucagon   | Recombinant glucagon   |
|                        |  |  |
| Obesity                | Liraglutide  | Recombinant glucagon-like peptide-1<br>(GLP-1) derivative  |
| Obesity<br>Haemophilia | Liraglutide<br>Eptacog alfa                                    | Recombinant glucagon-like peptide-1<br>(GLP-1) derivative<br>Recombinant activated factor seven (FVIIa)  |
| Obesity<br>Haemophilia | Liraglutide<br>Eptacog alfa<br>Turoctocog alfa                 | Recombinant glucagon-like peptide-1<br>(GLP-1) derivative<br>Recombinant activated factor seven (FVIIa)<br>Recombinant factor eight (FVIII)  |
| Obesity<br>Haemophilia | Liraglutide<br>Eptacog alfa<br>Turoctocog alfa<br>Catridecacog | Recombinant glucagon-like peptide-1<br>(GLP-1) derivative<br>Recombinant activated factor seven (FVIIa)<br>Recombinant factor eight (FVIII)<br>Recombinant factor thirteen (FXIII) |

# PRODUCTION

# Focusing on safe use of gene technology

Novo Nordisk uses genetically modified yeast cells, bacteria and mammalian cells for the production of biological medicines.

Many proteins can be produced in yeast or *E. coli* bacteria, but more complex proteins cannot. For the production of blood clotting factor VIIa, Novo Nordisk needs to use mammalian cell cultures such as BHK cells. The BHK cells were originally isolated from hamster kidneys in 1961, but can multiply indefinitely in the laboratory.

Authorities categorise genetically modified cells by the potential risk they might pose for human health and the environment. Novo Nordisk only uses production cells in the lowest risk category (risk group 1), where there is no known risk to humans or the environment, and all our production organisms have the internationally recognised GRAS status (Generally Recognized As Safe) approved by the US Food and Drug Administration.

# Production in a controlled, contained production system

Production cells are cultivated in large-scale growth facilities called fermentation tanks, where they are given the optimal conditions to grow and reproduce. Each of the large number of cells functions like a microscopic factory producing the pharmaceutical protein.

Novo Nordisk's production complies with all regulatory requirements, and takes place in a controlled, contained production system.

This means that all substances and fluids containing genetically modified cells are kept in closed pipes and tanks throughout the entire fermentation and purification processes, to ensure that living cells or active genes are not released into the environment. Furthermore, waste streams are inactivated by heat treatment before discharge to the environment.





## CONTAINED PRODUCTION

When a sufficient quantity is reached, the pharmaceutical protein is separated from the production cells, followed by an extensive purification process. As a result, Novo Nordisk's products do not contain genetically modified microorganisms or genetic material.

#### EPHREM RUDAHUNGA Product Supply Novo Nordisk Denmark

#### Waste used as raw material for biogas

The growth media in which the production cells are grown vary depending on the type of cells used, but the media mainly comprise agricultural crops, sugar, salts and water. After the protein has been harvested, production waste consists of the remains of the growth media and the genetically modified production cells.

Novo Nordisk uses the heat-treated waste from fermentation and recovery as raw material for biogas generation. The biogas facility in Kalundborg, Denmark, produces as much electricity as seven ocean windmills and reduces Novo Nordisk's CO<sub>2</sub> emission by 21,000 tons per year.

## **Risk of accidental release**

One aspect of the use of gene technology that causes concern is the risk of accidental release of genetically modified cells like yeast or *E. coli* bacteria into the environment. The genetically modified cells used by Novo Nordisk do not present any known risk to humans or the environment since the cells are all classified by authorities as low-risk organisms, i.e. class 1. In the rare event that genetically modified cells are accidentally released into the environment, Novo Nordisk has strict guidelines for handling and evaluating of the situation, and all events are immediately reported to the relevant authorities.

"Very few accidental releases have actually occurred. We conduct investigations for GMOs in the environment around the factories on a regular basis, and we have never found any GMOs," says Niels Bagge, Ph.D in molecular microbiology at Novo Nordisk. "Based on many years of experience it is our assessment that our genetically modified cells do not survive in nature. The cells are very weak and not fit to survive in the environment with scarce nutrients and competition from naturally occurring microorganisms."

# LEGISLATION AND GLOBAL STANDARDS

Protecting people and the environment

Novo Nordisk is committed to a safe application of gene technology, and supports regulation on its use. This approach ensures that the application of gene technology minimizes any threat to humans or the environment. The company was actively involved in the world's first legislation regulating the use of gene technology, which was adopted in Denmark in 1986.

Today, most countries strictly regulate the use of gene technology, and companies must obtain approval from national authorities before any kind of research, development or production may be initiated.

## Authorisation and inspection

National authorities evaluate the precautions taken to ensure that genetically modified cells are safely handled, in order to protect employees and the environment. Authorisation is granted only if the high safety conditions and requirements from the authorities are continuously met. Authorities perform inspections to confirm that regulations are followed in all processes where gene technology is used. Furthermore, for production we only use genetically modified cells that are classified as low risk, i.e. class 1, with no known risk to humans or the environment.

## **Global standards and governance**

Novo Nordisk has research centres in Denmark, China and the United States and production plants in Denmark, the United States, France, Brazil, China, Algeria, Russia and Japan. In these countries, Novo Nordisk collaborates with the authorities to ensure compliance with national legislation, as well as Novo Nordisk's own high global standards. Novo Nordisk has a comprehensive governance structure with specialist groups and committees that continuously assess any potential risk of activities involving gene technology. Thorough internal procedures govern the use of gene technology, and risk assessments and internal audits of





production and pilot facilities are regularly performed. Extensive monitoring verifies that Novo Nordisk is in compliance with legal and internal requirements. "In production and pilot facilities we frequently take samples to monitor the working environment, waste, wastewater and air emission. In addition, the authorities perform control inspections on a regular basis, to ensure that all requirements are met," explains Henrik Wulff, Novo Nordisk's executive vice president, Product Supply.

## A precautionary approach

Novo Nordisk upholds a precautionary approach in accordance with the "Precautionary Principle", which was formalized by world leaders at the Earth Summit meeting in Rio de Janeiro in 1992. If there are any reasonable concerns that an activity could cause harm either to people or the environment, preventive measures are applied even if the activity has not been proven unsafe.

# PATENTING AND GENE TECHNOLOGY

Patents for commercial use of genes and proteins

The ability to patent, i.e. to legally secure intellectual property rights to a given invention, serves as a strong incentive for the continued pursuit of innovative discovery around the world. In particular, patent protection continues to be a key driver for the discovery of new life-improving and life-saving medicines and devices. Since scientists have the right to seek patent protection on their work, they can more easily share new insights with their peers to further scientific understanding while still maintaining the right to exclusively commercialise their discovery for a limited period of time.

As a research-based pharmaceutical company, patent protection is of vital importance to Novo Nordisk in our aspiration to develop new medicines that benefit patients. We also see patent rights as a very important tool for promoting innovation to address unmet treatment needs, leading to new and better products and processes, and stimulating long-term economic growth and job creation.

# Patenting of genes and proteins for commercial use

Pharmaceutical proteins and the commercial use of genes can be patented. This means that only the patent holder can use the patented gene sequence or protein commercially for a limited period of time. However, use for non-commercial research purposes and private use does not require permission by the patent holder. The process of bringing new medicines to patients is long, costly and prone to a high risk of failure due to the complexity of turning scientific breakthroughs into safe and effective therapies for humans. On average, it takes at least 10 years to develop a new drug for market approval at an average cost of more than 1 billion US dollars. Since drug patents typically run for 20 years, a company then has roughly 10 years of commercial exclusivity left to market the drug and secure a return on its initial investment in development.

This commercial exclusivity is the backbone of the drug industry, allowing companies to continue to invest in future R&D activities that can potentially bring even more new and better treatments to the patients who need them. KARIN HAMBORG ALBRECHTSEN Global Research, Obesity Novo Nordisk Denmark

# PATENTING BIOTECH INVENTIONS

Novo Nordisk is committed to advancing the responsible use of intellectual property rights for the benefit of human health.

- Novo Nordisk supports the principle that the human body, at the various stages of its formation and development, cannot constitute patentable inventions (Article 53, Rule 29(1) of the European Patent Convention).
- Novo Nordisk will support the advancement of biomedical research by licensing, under fair terms, patents covering research tools and diagnostic agents.
- Novo Nordisk supports the principle that patents shall not be granted in respect of inventions that concern processes for modifying the genetic identity of animals which are likely to cause them suffering without any substantial medical benefit to man or animal, or that concern animals resulting from such processes (Article 53(a), Rule 28(d) of the European Patent Convention).

# ADDRESSING ETHICAL ISSUES

Governance system ensures high standards

Cutting edge research, development and innovation are part of our way of working, which includes applying results from the fast and remarkable progress of biotechnology. At the same time, biotechnological development confronts our societies with new ethical dilemmas. Novo Nordisk recognises the concerns associated with the use of gene technology and realises that safety and ethics are important in managing modern biotechnology. We stay aware and we engage in stakeholder dialogue and partnerships to help us deal with ethical dilemmas.

Novo Nordisk has established a comprehensive governance system to ensure that the company's own high standards are met as well as to remain compliant with regulations.



JESPER LAU Research & Development Novo Nordisk Denmark

## Social and Environmental Committee

Novo Nordisk's bioethical work is governed by the Social and Environmental Committee, which is mandated and chaired by Novo Nordisk's Executive Management. The Committee is responsible for the company's policy and strategy on all bioethical issues including gene technology.

### **R&D Bioethics Council**

The Research and Development Bioethics Council suggests new initiatives and strategies for the Social and Environmental Committee, and develops and implements new policies and guidelines.

#### Expert group on gene technology ethics

The expert group, with members from all areas of Novo Nordisk using gene technology, ensures that issues related to gene technology are handled in a coordinated and consistent manner. The expert group reports to the Research and Development Bioethics Council.

### **Global Bioethics Department**

Global Bioethics Management drives and coordinates all new initiatives ensuring Novo Nordisk's business activities are ethically sound and that ethical concerns are addressed. The department supervises the company's handling of bioethical issues worldwide, monitors trends and engages with stakeholders.

# ENGAGING WITH STAKEHOLDERS

Open, honest and transparent

Novo Nordisk seeks to stay attuned to public views and concerns about the use of gene technology. We see it as our obligation to communicate on any issue with a perceived risk to society and engage in an open, honest and transparent dialogue with stakeholders.

#### Scientific collaborators

We share our passion for proteins in hundreds of academic industry partnerships to jointly develop new solutions within our therapeutic areas.

We support the scientific community through scientific publications, co-financing of Ph.D and postdoctoral students, and by providing scholarships to master's students.

As an example, Novo Nordisk recently supported and provided input, including case stories, to educational material on gene technology produced and published by the Technical University of Denmark. Novo Nordisk also supports non-commercial research, and grants licence to use the company's patents for research tools and diagnostic agents under fair terms consistent with the advancement of biomedical research.

#### Participation in networks

Novo Nordisk is active in various networks, e.g. the European Biosafety Association, and networks with other biotech companies. Through these networks, Novo Nordisk monitors and takes an active part in the development of international standards for gene technology, providing information to legislators and regulators.

#### **Authorities**

Novo Nordisk is in close dialogue with relevant authorities concerning GMO-related issues. All production and pilot plants as well as laboratories are approved and classified according to national legislation on GMOs and inspected by the authorities on a regular basis. In case of an accidental release of material containing GMOs, the relevant authorities are informed immediately.

## NGOs and neighbour meetings

Novo Nordisk is open to dialogue with various non-governmental organisations about GMO-related issues whenever it is relevant.

Neighbours in the local community living near Novo Nordisk's production sites are invited to information meetings if they are concerned about new GMOrelated issues. This is to provide the community with the possibility of voicing any concerns, e.g. about the safety of using gene technology, and to discuss Novo Nordisk's approach to addressing such issues.

Maria Bird and her grandchildren South Africa Maria has type 2 diabetes

## TAKE A CLOSER LOOK

Ethical considerations are part of everyday life in research and development at Novo Nordisk. This brochure is part of a series of brochures on bioethical issues. You can download these brochures and find further information on Novo Nordisk's approach to the use of gene technology on Novo Nordisk's bioethics webpages: **novonordisk.com/rnd/bioethics** 

Contact

Novo Nordisk welcomes feedback, comments and suggestions on this brochure. Send your comments to **bioethics@novonordisk.com** 





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