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Unravelling the infection enigma: Jean-Laurent Casanova's pioneering genetic discoveries earn him the 2025 Novo Nordisk Prize

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For decades, scientists believed that infections were determined solely by viruses and bacteria. But Professor Jean-Laurent Casanova's groundbreaking research has revealed a more complex reality: genes play a fundamental role in determining who gets seriously ill and who stays healthy. Because of his pioneering discoveries, he is being honoured and awarded with the 2025 Novo Nordisk Prize.

Jean-Laurent Casanova's research, spanning more than three decades, has shown that rare or not-so-rare genetic mutations can make some individuals especially vulnerable to infections that others shrug off. "Why would a child be hospitalised for viral pneumonia, tuberculosis or any other severe infection when most children infected with the very same microbe do well? That is what I call the infection enigma," he explains.

His pioneering work has uncovered more than 70 genes that, when mutated, impair the body's ability to fight off specific infections. This research has not only deepened understanding of human immunity but also led to new possibilities for patient care – helping clinicians better predict, diagnose and treat infectious diseases based on individual genetic profiles.

Recognising a landmark scientific contribution
Mads Krogsgaard Thomsen, CEO of the Novo Nordisk Foundation, emphasises the significance of Jean-Laurent Casanova's contributions: "His work exemplifies the power of integrating clinical observation with genetic research. By uncovering the genetic basis of susceptibility to infections, Professor Casanova has opened new avenues for personalised medicine, offering hope for more effective treatments and preventive strategies."

Professor Jørgen Frøkiær, Chair of the Novo Nordisk Prize Committee, adds: "Jean-Laurent Casanova's research has transformed understanding of infectious diseases by revealing the critical role of genetic factors. His discoveries have provided new insight into why some individuals are more vulnerable to infections, paving the way for novel approaches in immunology and public health."

For Jean-Laurent Casanova, the recognition is a surprise but also validates a career dedicated to reshaping how we understand infections. “When I got the call, I had no idea I had even been nominated,” he says. “But this is by far the most important award I have received in my career, and I am incredibly honoured.”

It is not just about the virus

Jean-Laurent Casanova’s journey began in Paris, where he simultaneously studied medicine and biology, tailoring his own MD and PhD programme long before such dual-degree tracks existed in France. His decision to specialise in paediatrics and immunology shaped the focus of his research.

“As a young paediatrician, I saw children die from infections in intensive care units,” he recalls. “That made me realise that infection was the biggest problem in paediatrics. I wanted to understand why some children got severely ill while others did not.”

At the age of 30 years, he took on the infection enigma as his life’s work, starting his laboratory in Paris before later expanding to New York. Over the years, his team has demonstrated that genetic errors in immunity explain why certain individuals have severe infectious diseases – insight that has proved vital in times of global health crises, including the COVID-19 pandemic.

Jean-Laurent Casanova’s discoveries have changed how we understand and treat infections. One of his biggest breakthroughs came during the COVID-19 pandemic, when his team found that some people had “bad” antibodies – called autoantibodies – that attacked their own immune system instead of the virus. These autoantibodies block type I interferons, which are crucial for fighting infections. His research showed that these faulty antibodies were responsible for about 15% of severe COVID-19 cases and 20% of deaths.

“This was clear proof that a person’s genes and immune system play a big role in how sick they get from infections,” he explains. “It is not just about the virus – it is also about how your body responds to it.”

Convincing the scientific community was not easy

These harmful autoantibodies are not just a COVID-19 problem. Casanova’s team found them in other severe viral infections, such as influenza and West Nile virus, in which they explain nearly 40% of the worst cases. “If you have these autoantibodies, you have to be extra careful about infections and insect bites that spread viruses,” Casanova warns.

"Testing older adults for these antibodies could also help to save lives in countries that can afford it."

Casanova's team first found that rare genetic mutations prevented some people from producing type I interferons. Later, they discovered that autoantibodies could do the same thing – blocking immune defences and increasing the risk of severe infection. This breakthrough helped to explain why some people get critically ill whereas others recover quickly.

"These individuals can be identified through genetic testing or by screening for autoantibodies in their blood. Once diagnosed, some patients may benefit from treatments such as interferon therapy to replace the missing immune signal or therapies to remove the harmful autoantibodies, helping to restore their body's ability to fight infections."

For a long time, scientists mainly focused on germs – bacteria and viruses – as the reason people got sick. But Casanova's discoveries challenged this thinking, showing that individual differences in the immune system also matter. Changing this perspective took time, since many researchers were initially sceptical.

"For more than a century, we have been taught to focus almost entirely on microbes," Casanova says. "But genetics has always played a role – this was proven for plants over 100 years ago and for humans before World War II. We just did not fully appreciate it."

A future shaped by genetic insight

As the field of infectious disease research continues to evolve, Casanova's discoveries offer a clear path forward. The ability to identify genetic vulnerability before illness strikes makes the potential for personalised interventions – such as tailored vaccination programmes and lifestyle adjustments – greater than ever.

Casanova's work is not just focused on understanding infections – it focuses on rewriting the medical playbook for how to prevent and treat them. "By studying rare patients with rare genetic vulnerabilities, we uncovered something that affects millions," he says. "This is just the beginning."

With the 2025 Novo Nordisk Prize, his contributions take centre stage, marking a milestone in the pursuit of a more personalised and effective approach to infectious disease medicine.

The 2025 Novo Nordisk Prize will be awarded at a ceremony in Bagsværd,

Denmark, on April 25, to Professor Jean-Laurent Casanova from Necker Medical School in Paris, France and the Rockefeller University in New York, USA. A Prize Lecture by Jean-Laurent Casanova will take place at the Panum Institute, University of Copenhagen, Denmark in the Niels K. Jerne Auditorium, Building 13 on April 24, the day before the official award ceremony.

About Jean-Laurent Casanova

- 1987 MD, University of Paris Descartes, France
- 1992 PhD in Immunology, University of Paris Pierre and Marie Curie, France
- 1999 Professor of Paediatrics, Necker Medical School, Paris, France
- 1999 Co-founder, Laboratory of Human Genetics of Infectious Diseases, Institut *Imagine*, Paris, France, Inserm, AP-HP, Université Paris Cité
- 2008 Professor, ~~the~~ Rockefeller University, New York
- 2014 Investigator, Howard Hughes Medical Institute, ~~Chevy Chase, MD, USA~~
- 2015 Foreign Member, United States National Academy of Sciences
- 2015 Foreign Member, United States National Academy of Medicine

About the Novo Nordisk Prize

The Novo Nordisk Prize recognises active scientists who have provided outstanding international contributions to advance medical science to benefit people's lives. The prize is awarded annually by the Novo Nordisk Foundation and is intended to further support biomedical research in Europe.

The prize is accompanied by DKK 5 million (€672,000) and comprises a DKK 4.5 million (€605,000) research grant and a personal award of DKK 0.5 million (€67,000). The Foundation will award an additional DKK 0.5 million for hosting an international symposium within the recipient's field(s) of research.

Further information

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