

Nobel Prize in Physiology or Medicine 2025: new horizons for animal health and care

2025 Volume 2, Article number: e027

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<https://doi.org/10.48130/animadv-0025-0043>

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Received: 8 October 2025

Accepted: 9 October 2025

Published online: 10 October 2025

Citation: Liu G, Zeng G. 2025. Nobel Prize in Physiology or Medicine 2025: new horizons for animal health and care. *Animal Advances* 2: e027
<https://doi.org/10.48130/animadv-0025-0043>

The Nobel Prize in Physiology or Medicine 2025 has shed new light on the intricate workings of the immune system, particularly through the discovery of regulatory T cells—often referred to as the immune system's 'security guards'. This groundbreaking research not only deepens the understanding of immunology but also opens up exciting new possibilities for animal farming and pet care.

On October 6, 2025, the prestigious Nobel Prize was awarded to American scientists Dr. Mary E. Brunkow and Dr. Fred Ramsdell, along with Japanese scientist Dr. Shimon Sakaguchi. Their work has fundamentally changed the understanding of 'peripheral immune tolerance', revealing the critical role of regulatory T cells (Tregs) in preventing the immune system from attacking the body's own tissues and maintaining overall immune balance^[1].

Three pioneering discoveries

This year's Nobel laureates have unveiled the mechanisms by which the immune system distinguishes between self and non-self, thereby avoiding attacks on the body's own tissues. Their discoveries have laid the foundation for a new era in immunology.

In 1995, Dr. Shimon Sakaguchi made a groundbreaking discovery that challenged the prevailing belief that immune tolerance was primarily achieved through 'central tolerance' mechanisms. He identified a specific subset of CD4⁺ T cells endowed with immune-suppressive functions—regulatory T cells (Tregs), characterized by the presence of CD4⁺CD25⁺. These cells function as vigilant sentinels, ensuring tolerance to self-tissues and preempting autoimmune reactions^[2].

Building on this foundation, Drs Mary E. Brunkow and Fred Ramsdell made a significant breakthrough in 2001. Through their studies on mouse models prone to autoimmune diseases, they discovered that mutations in the *Foxp3* gene were responsible for autoimmune conditions, termed the 'scurfy' mutations. In humans, mutations in the corresponding gene lead to a rare but fatal hereditary autoimmune disorder known as IPEX syndrome^[3].

In 2003, Dr. Sakaguchi connected these discoveries, demonstrating that the *Foxp3* gene controls the development and function of regulatory T cells or Tregs. Together, these findings established the new research field of 'peripheral immune tolerance', opening up new avenues for understanding and treating autoimmune diseases^[4].

Transforming animal farming

The discovery of regulatory T cells carries significant ramifications for animal husbandry. Autoimmune disorders and chronic inflammation are not merely challenges to human health; they also afflict livestock, adversely affecting their welfare and productivity.

In farming environments, animals often face high stocking densities and multiple environmental stressors, which can disrupt immune system balance. Regulatory T cells act as the immune system's 'brake system,' actively maintaining immune balance through the secretion of special cytokines and suppression of immune effector cells^[5,6].

Common autoimmune symptoms and chronic inflammatory responses in livestock may be intricately associated with compromised regulatory T cell functions. By elucidating the mechanisms underlying these cells and the conditions conducive to optimizing their functionality *in vivo*, veterinary professionals can assist farmers in refining rearing environments and mitigating stressors to foster immune system equilibrium and diminish disease prevalence. This approach could culminate in healthier animals, a reduced dependency on pharmaceuticals, and enhanced overall agricultural productivity^[7].

New insights for pet care

For pet owners, the Nobel-winning research offers fresh perspectives on animal care. The function of regulatory T cells is closely related to pet health. When these cells fail to work properly, the immune system may uncontrollably attack the body's own tissues, leading to various autoimmune disorders^[8].

In pets, conditions like cancer, allergies, skin diseases, and intestinal inflammation are often associated with immune system dysregulation. Dr. Sakaguchi's vision, expressed at the press conference, that 'some-day cancer will no longer be a feared disease that can be cured', applies equally to veterinary medicine^[9].

Therapies based on regulatory T cells are being actively explored for treating human autoimmune diseases such as type 1 diabetes and rheumatoid arthritis. These advances may eventually translate into new approaches for pet healthcare, offering hope for better management and treatment of autoimmune conditions in beloved pets^[10].

Future prospects for immune balance

As the understanding of regulatory T cell function deepens, new methods for maintaining immune balance are emerging. The Nobel Committee noted that the laureates' discoveries have advanced treatments for cancer and autoimmune diseases and show promise for improving transplantation success rates.

Currently, several related therapies have entered clinical trial stages. In animal care, nutritional regulation represents an important approach to maintaining immune balance. Research shows that metabolites from gut microbiota, including short-chain fatty acids like butyrate, can significantly influence immune function. Optimizing diets and supplementing specific nutrients may help maintain immune health in pets and farm animals^[11,12].

Future animal care strategies will likely focus more on precise regulation of the immune system rather than simply enhancing or suppressing immune responses. This shift in approach could lead to more effective and targeted treatments, improving the overall health and well-being of animals.

Conclusions

The portraits of the three laureates on the Nobel Prize website are a testament to how basic scientific discoveries can transform our understanding of the world and improve lives. Dr. Brunkow initially thought the notification was a scam call; Dr. Ramsdell was potentially unreachable while mountain hiking, and Dr. Sakaguchi received congratulations from Japan's Prime Minister. Their dedicated work spanning over 30 years has not only revealed the inner workings of the immune system but also provided new directions for animal care.

On farms and in households, a deeper understanding of immune balance can help create healthier living environments for animals. By harnessing the power of regulatory T cells, animals can naturally resist diseases without a heavy reliance on medications. This Nobel Prize-winning research marks a significant step forward in the quest for better animal health and care.

Author contributions

The authors confirm their contributions to the paper as follows: study conception and draft manuscript preparation: Liu G; manuscript review and revision: Zeng G. Both authors reviewed the results and approved the final version of the manuscript.

Data availability

The data that support the findings of this study are available in the PubMed.

Conflict of interest

The authors declare that they have no conflict of interest.

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