



## Popular Article

# Role of Research Animals in Medical Breakthroughs

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### *Abstract*

Scientific advances helped in the in-depth exploration of various life processes to a great extent. Research animals had a significant contribution in this regard ranging from an understanding of basic biological processes to various diagnostic modalities, and models to study diseases, treatments, and therapies. The research animals include rats, mice, rabbits, hamsters, guinea pigs, ferrets, dogs, and non-human primates. Contributions of these animals include- smallpox eradication using the smallpox vaccine developed in cow, the development of the Polio vaccine using research on mice, dogs, and monkeys, development of medications to treat HIV/AIDS, cancer, Alzheimer's, hepatitis, and malaria using non-human primates and many more. Besides this, a significant contribution to almost every Nobel Prize in Medicine has been made by using laboratory animals. The present article tries to commemorate the role played by research animals in bringing out medical miracles and advises researchers to follow 3R's principles concept of Russell and Burch, although a growing concern over the use of research animals has been reported in the last few years.

### **Introduction**

Humans and animals get exposed to a variety of infectious as well as non-infectious materials posing a risk to their life. This can lead to the emergence of various ailments due to disturbances in the balance of health and disease.

These disturbances were then assessed, diagnosed, and treated using scientific advances. Scientific advances recognized as a miracle helped the process of in-depth exploration of various life events to a great extent. Animals in

particular research animals had a significant contribution to this scientific advancement of exploration of human biology and the development of new medicines and treatments (Nabr.org). **The research animals include rats, mice, rabbits, hamsters, guinea pigs, ferrets, dogs, and non-human primates (Pfizer.com).**

Besides providing an understanding of diseases, laboratory animals are also crucial for assessing the safety of a wide range of compounds, including medications, vaccines, food additives, household items, workplace toxins, cosmetics, water, and air pollutants, and many more. These facts are further supported by compulsory preclinical safety evaluation of chemicals due to deadly incidents in the past like the thalidomide tragedy in 1950, use of lash lure mascara, and ethylene glycol poisoning in children due to Elixir (National Research Council (US) Committee, 2004).

Highlighting the role of research animals in total, an important question always strikes my mind, why only animals and not humans? For many reasons, using animals as research subjects is a wonderful idea. They are subject to many of the same health issues as humans because of their similar biology. They also have brief life cycles, making it simple to study them throughout the course of their entire lives or across several generations. Additionally, unlike with humans, scientists may regulate the environment the animal is in (food, temperature, lighting, etc).

Besides this, research involving human beings seems to be impractical and unethical. In addition, avoiding health risks associated with new therapies and treatments is the reason that paved the way for use of animals in research (Physiology.org).

### **Role of Research Animals in Biological Exploration of Diseases and Development of Therapeutics**

Science involving research animals has always been an exemplar for decades, from a biological understanding of diseases like smallpox to determining the safety and efficacy of products brought to market today. Besides this, a significant contribution to almost every Nobel Prize in Medicine has been made by using laboratory animals. The following some of examples highlight the role of research animals in various diseases:

**1. Diabetes:** Dogs, mice, rats, and nonhuman primates were the instrumentals involved in the successful generation of therapy for diabetes (fbresearch.org). Studies using dogs started in 1682, with further validation of the role of the pancreas in diabetes and the successful isolation and injection into humans in the year 1922. For this discovery, Banting and MacLeod received the Nobel Prize for Physiology or Medicine in the year 1923 (Vecchio et al., 2018). Type 1 diabetes research primarily employs nondiabetic mice

(NOD) whereas type 2 involves KK mice and Zucker Diabetic Fatty (ZDF) rats.

**2. HIV:** HIV, as a global public health concern, has affected 40.1 million people to date across the globe, with the result of 6,50,000 people's death in 2021 (WHO.Int, 2022). To cure this, FDA has approved 222 antiretroviral drugs for global HIV/AIDS relief (FDA.Gov). Humanized mouse models and non-human primate models have been shown to be promising models for a deeper understanding, of anti-retroviral therapies, and HIV vaccine.

**3. COVID-19:** *In vivo* research employing various animal models, viz. mice, ferrets, nonhuman primates and hamsters -CoV-2 helped to generate substantial information related to the pathogenesis and transmission of SARS-CoV2. This further has accelerated the development of anti-viral therapeutics and vaccines (Chu et al., 2022).

**4. Polio:** Dramatic reduction in polio, a viral disease of under 5 years of age children from reported 3,50,000 cases in 1988 to 6 cases in 2021 was possible due to the development of the polio vaccine by Salk and Albert Sabin in 1950. For this dramatic victory over polio, the contribution of several monkeys, mice, and human beings enrolled in trials needs to be considered as nearly 1500 monkeys (about 1500)

sacrificed to produce 1 million inactivated doses of vaccine (Baicus, 2012).

### **Breakthrough Nobel Prize Discovery Employing Research Animals**

The following **Table No.1** depicts last 10-year breakthrough Nobel Prize Discovery Employing Research Animals and **Figure No.1** illustrates animal models used in various discoveries awarded with in Nobel Prize of Physiology or Medicine (Taken from <https://fbresearch.org/medical-advances/nobel-prizes/>, and Baptista et al., 2021).

### **Another side of Coin- Alternatives to Animal Use**

There exists variation in the overall picture of disease progression and treatment protocol and their effects between research animals and human beings on account of intrinsic and extrinsic factors. Use of research animals has created landmark discoveries in the history, nonetheless, New Alternative Methods Program focussing on 3R's principle of Replace, Reduce, and Refine of Russell and Burch was set out by the US Food and Drug Administration (FDA). This move was taken with an aim to produce human relevant data, optimizing product development at reduced expenditure keeping concern over the use of research animals in mind (Nuwer, 2022). These FDA alternatives include various *in silico* approaches like simulation

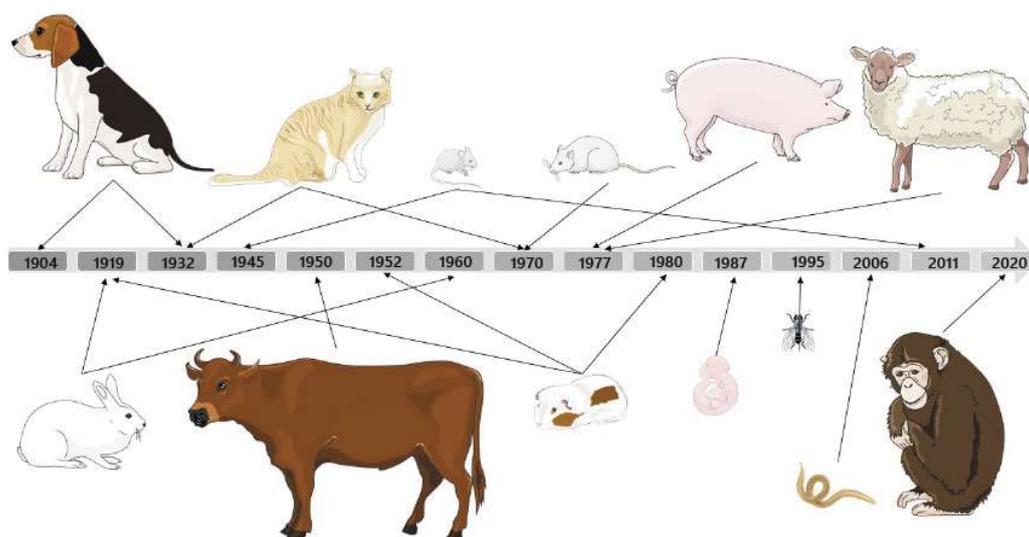
models, extended decision tree software. Other includes organ on a chip, use of *Caenorhabditis elegans* (*C. elegans*), and different *in vitro*

cellular system like microphysiological system, stem cells etc.

**Table No.1 Breakthrough Nobel Prize Discovery Employing Research Animals**

<b>Year</b>	<b>Researcher</b>	<b>Animals used</b>	<b>Topic</b>
2021	David Julius and Ardem Patapoutian	Mice	For their discoveries of receptors for temperature and touch
2020	Harvey J. Alter, Michael Houghton and Charles M. Rice	Chimpanzees	For the discovery of the hepatitis C virus
2019	William G. Kaelin Jr., Sir Peter J. Ratcliffe and Gregg L. Semenza	Mice	for their discoveries of how cells sense and adapt to oxygen availability
2018	James P. Allison and Tasuku Honjo	Mice	for their discovery of cancer therapy by inhibition of negative immune regulation
2017	Jeffrey C. Hall, Michael Rosbash and Michael W. Young	Fruit Flies	Discoveries of molecular mechanisms controlling the circadian rhythm
2016	Yoshinori Ohsumi	Mouse	Discoveries of mechanisms for autophagy
2015	William C. Campbell and Satoshi Ōmura	mice, dogs, sheep, cattle, chickens, monkeys	Discovery of therapy against infections caused by roundworm parasites
2015	Youyou Tu	mice, dogs, sheep, cattle, chickens, monkeys	Therapy against Malaria
2014	John O'Keefe and May-Britt and Edvard I. Moser	rats	Discoveries of cells that constitute a positioning system in the brain (an inner GPS)
2013	James E. Rothman, and Thomas C. Südhof	Mice, hamsters	For their discoveries of machinery regulating vesicle traffic, a major transport system in our cells
2012	Sir John B. Gurdon	Frogs, mice	For the discovery that mature cells can be reprogrammed to become pluripotent
2012	Shinya Yamanaka	Frogs, mice	For the discovery that mature cells can be reprogrammed to become pluripotent

**Figure No.1 Time trend depicting animal models used in various discoveries awarded with Nobel Prize of Physiology or Medicine (Taken from: Baptista et al., 2021)**



## Conclusion

Science involving research animals has created a landmark from a biological understanding of various diseases like smallpox, HIV, malaria, COVID-19. In addition, research animals were used in safety, efficacy, production of various medicinal products and saved countless number of humans and animals. They also helped in breakthrough discoveries with a significant contribution to almost every Nobel Prize in Physiology or Medicine. At the same time, the overall picture of disease progression and treatment protocol and their effects vary to an extent in research animals and human beings. The aforesaid variation and global concern over

the use of research animals necessitate an alternative approach to be employed to generate human relevant data, optimizing product development at reduced expenditure keeping 3R's principle in mind.

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