

FORUM: Special Conference (SPECON)

QUESTION OF: Ethical considerations in the use of animal testing in pharmaceutical research

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INTRODUCTION

The first recorded cases of animal testing were during the Antiquity, when ancient Greek and Chinese healthcare practitioners would dissect animals to better understand how their bodies worked. Nowadays, animal testing is the primary reason why most of the medicine we use has been released. During the development and evaluation process of drugs, animals are exposed to chemicals included in the drug to assess it and thus its danger level.

After the 19th century, with the surge in animal rights movements after scientific publications that changed public views on animal testing, the modern animal rights movement has been in operation to completely ban animal testing. In the earlier stages of medicine, animal testing was one of, if not the only, ways to progress in the field, thus making it globally acceptable. Nowadays, the ethics behind current medical breakthroughs are being questioned, seeing as transparency towards the treatment of animals during captivity and the procedures they undergo is insufficient. Campaigns and organizations established for the cause have dedicated themselves to achieving the legal recognition of animal rights, implementing detailed and strict guidelines and raising awareness about the nature of the medicine we are consuming.

Whether it is the rights and value of animals, the exploitative and sometimes torturous procedures or the lack of accountability and legal intervention, the current situation raises the question of whether it is ethical and morally acceptable to use animals in research, which helps humanity progress, when they are being mistreated and violated. In this case, there is a silver lining that conventionally determines to which extent animal testing is animal abuse. Finding balance between the need for rapid medical development and moral considerations is key to resolving any controversy and eventually issues regarding the matter.

DEFINITION OF KEY TERMS

Animal cruelty

Animal cruelty refers to “willful or wanton infliction of pain, suffering, or death upon an animal or the intentional or malicious neglect of an animal.”¹

Animal crushing

Animal crushing refers to the “actual conduct in which 1 or more [animals] is intentionally crushed, burned, drowned, suffocated, impaled, or otherwise subjected to serious bodily injury.”²

Bioethics

Bioethics refer to “the ethics of medical and biological research.”³

In chemico

In chemico refers to the “identification of reactive compounds.”⁴

In silico

In silico refers to “computational models that investigate pharmacological hypotheses using methods such as databases.”⁵

¹ "Cruelty to Animals | Animal Welfare, Animal Rights & Animal Protection." Encyclopedia Britannica, 20 Feb. 2009, www.britannica.com/science/cruelty-to-animals.

² "Preventing Animal Cruelty and Torture (PACT) Act." Animal Welfare Institute, awionline.org/legislation/preventing-animal-cruelty-and-torture-pact-act.

³ Oxford English Dictionary. "Bioethics-Meaning and use." www.oed.com, www.oed.com/dictionary/bioethics_n?tab=meaning_and_use.

⁴ Cronin, Mark T. "The in Chemico-in Silico Interface: Challenges for Integrating Experimental and Computational Chemistry to Identify Toxicity." <https://pubmed.ncbi.nlm.nih.gov/20017580/>, PubMed

⁵ "What is in Silico?" *News-Medical.net*, 27 Oct. 2021, www.news-medical.net/life-sciences/What-is-in-Silico.aspx.

In vivo

In vivo refers to “happening or existing inside a living body.”⁶

Speciesism

Speciesism refers to “the idea that being human is a good enough reason for human animals to have greater moral rights than non-human animals.”⁷

Vivisection

Vivisection refers to “the cutting of or operation on a living animal usually for physiological or pathological investigation.”⁸

BACKGROUND INFORMATION

The history of animal testing

Animal testing is far from a new concept. The first recorded tests were conducted in Ancient Greece by renowned physicians of the time, such as Diocles and Erasistratus. They used vivisections as a means to better understand how living bodies work and react under certain circumstances. Similar practices were especially observed in Ancient Rome and China. Through vivisections or the dissection of animals, a huge step of progress was made in the medicinal field, allowing for theories and principles to arise and stay prominent in the field until the Renaissance.

⁶ "In Vivo." Cambridge Dictionary | English Dictionary, Translations & Thesaurus, dictionary.cambridge.org/dictionary/english/in-vivo

⁷ BBC. "The Ethics of Speciesism." BBC, www.bbc.co.uk/ethics/animals/rights/speciesism.shtml. Accessed 16 July 2024.

⁸ "What Is Vivisection, and Is Vivisection Legal?" PETA, 11 Aug. 2020, www.peta.org/features/what-is-vivisection/. Accessed 16 July 2024.

The first total ban on animal testing happened during the Middle Ages. Be that as it may, animal testing re-emerged during the 14th century, a period where significant progress in medical research was made, which ultimately paved the way for modern medicinal practices. This readoption of animal testing allowed for enormous amounts of theories and theses on animal biology and early biochemistry to be published. At the time, the welfare of the animals being tested upon was not being taken into consideration, despite some concerns being raised.

During the 18th century, animal rights activists, such as Frances Power Cobbe, started forming. This is the time when the ethical and moral considerations of animal testing, such as the ethical treatment of animals being used for research, are first expressed. However, the 19th century marks the official rise in animal activism: not only have the first anti-animal testing movements risen, but also the first animal protection organizations, such as the Society for the Prevention of Cruelty to Animals (SPCA)⁹, are in operation. These organizations mostly advocated for the ban of vivisections and animal dissections, as there had been growing concerns surrounding animal cruelty in the field of medicine.

The extended testing on animals was the primary reason why pharmaceutical and disease-curing development was marked during the twentieth century. Be that as it may, philosophers Peter Singer, author of "Animal Liberation", a publication that introduced speciesism into the question, and Tom Regan, author of "The Case of Animal Rights", argued that animals have the same rights as "infants and the severely mentally handicapped"¹⁰, caused a massive rift in the public's opinions regarding this ethical debate. Their influential work inspired many animal activists and organizations, pushing governments to focus on the ethical treatment of animals used in research and its justification. This public uprising, however, brought with it some violent ways of protest, such as organized terrorist attacks, and bias in the media.

In light of the situation, researchers William Russell and Rex Burch conducted a study that introduced the "Three Rs"¹¹, a principle that includes the replacement of in vivo test subjects, reduction of animal testing and refinement of the methods used in this sector of research. Although their work was largely overlooked, David H. Smyth, physiologist and researcher, reintroduced the principle in the late

⁹ "Who We Are." *Society for the Prevention of Cruelty to Animals*, 19 Dec. 2023, spca.org.sg/who-we-are/.

¹⁰ "Animal Experiments in Biomedical Research: A Historical Perspective." PubMed Central (PMC), www.ncbi.nlm.nih.gov/pmc/articles/PMC4495509/

¹¹ "Principles." The Johns Hopkins Center for Alternatives to Animal Testing, 12 Dec. 2023, caat.jhsph.edu/the-principles-of-humane-experimental-technique/.

1970s, allowing for the development of comprehensive and detailed regulations and guidelines for researchers testing on animals.

Animals used in pharmaceutical research

Taking up more than 90%¹² of the in vivo test subjects used in laboratories, rodents, such as mice and rats, and lagomorphs, usually rabbits, are the most used animal in biomedical research. Other animals, such as fish, dogs or pigs, are also commonly used for more specified research.

While researching the effects and possible cures for different types of cancer, mice and rats are subjected to chemicals to determine toxicity and cancer-eliminating effects. Furthermore, rats are sealed in tight spaces filled with cigarette smoke to determine its effects on humans, seeing as rats have similar reactions. Moreover, pregnant rabbits are forcefully fed various pesticides to conduct research on the potential reactions human mothers and babies would have to these pesticides.

As far as other animals are concerned, fish, such as zebrafish or goldfish, are used due to them being easily and widely accessible and rapid breeding. Zebrafish are used in genetics for their transparent embryos, whereas goldfish are used in neuroscience for the purpose of understanding behavioral patterns. Additionally, pigs have devices inserted into their system for scientists to document their reactions and potentially predict human reactions to these devices. What's more, dogs have been proven to show similar organ functions to those of humans, leading to not only the testing of chemicals that are used in up-and-coming medicine, but also the forced destruction of their organs.

¹² Shek, William R., and Diane J. Gaertner. "Microbiological Quality Control for Laboratory Rodents and Lagomorphs." PubMed Central (PMC), National Library of Medicine, www.ncbi.nlm.nih.gov/pmc/articles/PMC7150089/.

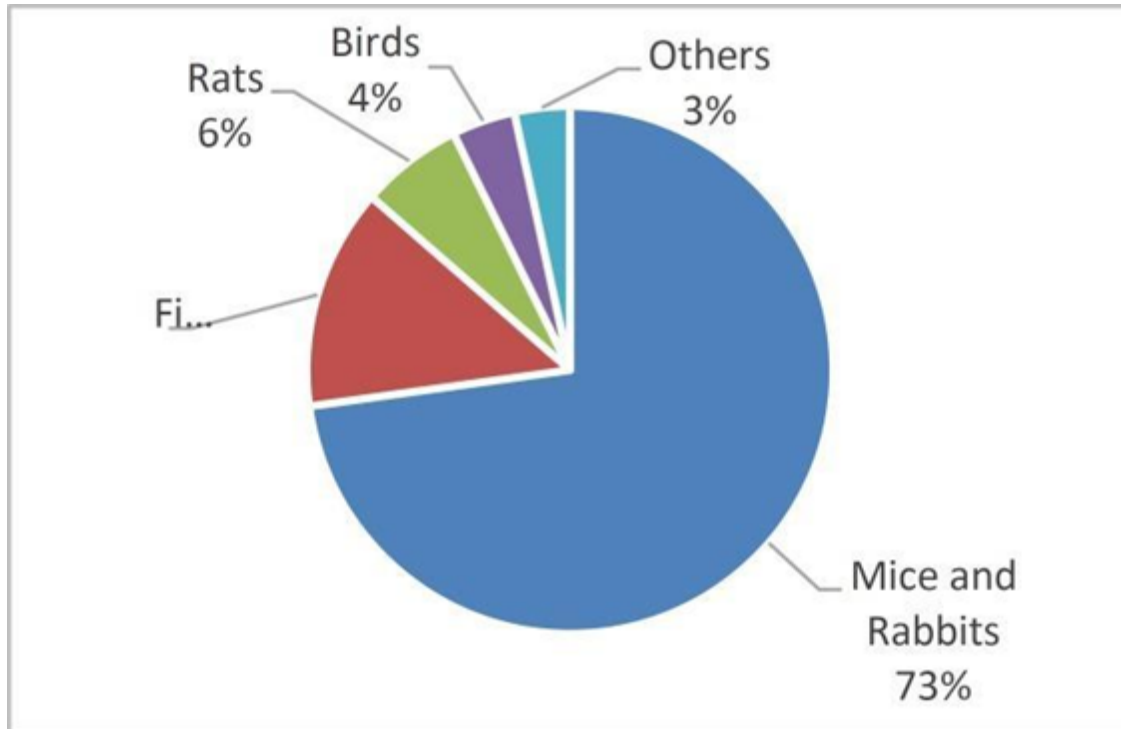


Figure 1: Types of animals used in testing in the UK¹³

The use of animal research in modern pharmaceutical research

Nowadays, over 115 million animals, including the ones mentioned above and more, are estimated to be used in laboratories all over the globe every year¹⁴. Whether it is for testing new medicine, drug assessment, simple experimentation or training of medical professionals, the number of animals used in pharmaceutical research seems to remain static despite efforts being made to find more ethical and sustainable alternatives that still grant the results and efficiency needed for medical progress.

The European Medicines Agency (EMA), in collaboration with the European Union (EU), has redefined and officially implemented the “Three Rs” principle. Following the 2010 Directive 63 of the European Parliament (EP), a legislation and regulatory guidelines, comprised of 66 articles and 8 regulatory annexes, have been implemented which aim for the protection of all animals that are used in

¹³ National Library of Medicine. "Types of animals used in research."
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7166243/figure/F2/>

¹⁴ "About Animal Testing." Humane Society International, 6 July 2023,
www.hsi.org/news-resources/about/.

scientific and medical research. All members of the EU are legally banned from this legislation. In addition to legislations, the international community is attempting to use New Approach Methods (NAMs), such as artificial intelligence (AI), machine learning models and High-Throughput Screening (HTS), an identification system for reactive compounds in drugs, as alternatives for animal testing.



Figure 2: The EMA's new definitions of the "Three Rs"¹⁵

Apart from the attempts of the international community, animal activism and a lifestyle that is more respectful and considerate towards animals has been adopted by the public. Led by the principle that "many nonhuman animals have basic interests that deserve recognition, consideration, and protection"¹⁶, thousands of new animal rights and welfare movements have come to combat the mistreatment and misuse of animals, especially in mass production farms and pharmaceutical and cosmetic laboratories and achieve the legal recognition of all animal's rights on all levels. Additionally, the increasing popularity of plant-based diets and veganism has affected the industry through the promotion of animal welfare. Despite all this, it is important to keep in mind that public opinions on this matter vary depending on factors such as region or animals being tested upon.

¹⁵ "Ethical Use of Animals in Medicine Testing." European Medicines Agency, www.ema.europa.eu/en/human-regulatory-overview/research-development/ethical-use-animals-medicine-testing.

¹⁶ "Animal Rights - Activism, Legislation, Ethics." Encyclopedia Britannica, 20 July 1998, www.britannica.com/topic/animal-rights/The-modern-animal-rights-movement.

Common procedures

One of the most common procedures conducted on animals is forced exposure to chemicals, toxins, pesticides and drugs. As stated by law, such as the FDA's New Drug Application (NDA)¹⁷, the latter needs to be tested to ensure the guidelines and safety protocols are being met. Some steps in this evaluation include the injection of the chemicals to discover side effects and the evaluation of results by local institutions¹⁸. Since these chemicals can be dangerous to humans, especially during the early stages of developing medicine, nonhuman in vivo specimens are experimented on, seeing as most of them provide accurate and human-like reactions to said drugs.

Vivisections, a practice that has been used to understand a body's physiology, structure, functions and reactions since the early days of medicine, still take up a large number of the tests performed on animals, although global statistics on this procedure are not recorded. Aside from their use in the usual regulatory testing that medicine undergoes during its development, vivisections are also used during exploratory research to aid in the discovery of new phenomena and the development of theses and theories.

According to the European Food Safety Authority, the genetic modification of animals is conducted under the premise of developing "new trait[s], such as disease resistance"¹⁹. In this procedure, scientists carefully take out certain parts of an animal's DNA, thus modifying its structure. This field of study focuses on research and development of potential solutions to global health issues, with the animals experimented on being used as models for simulating human-like reactions.

¹⁷ "Drug Development & Approval Process." *U.S. Food and Drug Administration*, 8 Aug. 2022, www.fda.gov/drugs/development-approval-process-drugs.

¹⁸ "The FDA's Drug Review Process: Ensuring Drugs Are Safe and Effective." *U.S. Food and Drug Administration*, 24 Nov. 2017, www.fda.gov/drugs/information-consumers-and-patients-drugs/fdas-drug-review-process-ensuring-drugs-are-safe-and-effective.

¹⁹ "The FDA's Drug Review Process: Ensuring Drugs Are Safe and Effective." *U.S. Food and Drug Administration*, 24 Nov. 2017, www.fda.gov/drugs/information-consumers-and-patients-drugs/fdas-drug-review-process-ensuring-drugs-are-safe-and-effective.

Case studies

The European Federation on Pharmaceutical Industries and Associations (EFPIA) collaborated with the European Medicines Association (EMA) to conduct a detailed report named “[Putting animal welfare principles and 3Rs into action](#)”²⁰ with the aim of evaluating the ways in which the “Three Rs” are being implemented by members of the EU “Beyond Compliance” section, presenting “industry pioneers”²¹ as examples to follow under “Leading by Example” and providing room for research and dialogue by presenting facts and ensuring transparency for the public in “Open Communications”

During the March 2024 meeting of the European Partnership for Alternative Approaches to Animal Testing (EPAA) in Ispra, Italy, the flash report on the workshop “NAM Designathon” was created and published by participants. This report summarizes the findings of research during the 2023 EPAA NAM Designathon, which focused on using NAMs as alternatives to animal testing. During the workshop, researchers and scientists from all over the EU came together to evaluate, create and discuss NAMs that would be used either as direct alternatives to animal testing or as leading examples for the field.

The research platform “Sage Journals” published a study²² that introduces the historical context of animal testing regulations. In this report, the authors present the history of animal testing and its regulations and the social impact they have had over the years. They conclude that the highly regarded results of animal tests have resulted in faulty safety standards regarding medicinal evaluation procedures. Moreover, they stress the importance of the public’s contribution to achieving this reduction and eventually also the complete ban of animal testing practices.

Ethical considerations and consequences of animal testing

When examining the ethics behind animal testing, both the moral and societal factors need to be taken into consideration and, when found contradicting each other, put in balance. In the case of animal testing, moral considerations, such as the ethical treatment of animals during research procedures, mostly align with elements of societal factors, such as the public’s opinion or governmental regulations.

²⁰ Putting animal welfare principles and 3Rs into action Pharmaceutical Industry Report 2022 Update. EPAA, 2024. www.efpia.eu/media/637068/putting-animal-welfare-principles-and-3rs-into-action.pdf.

²¹ EFPIA. Putting animal welfare principles and 3Rs into action. 2022. www.efpia.eu/media/637068/putting-animal-welfare-principles-and-3rs-into-action.pdf

²² "A History of Regulatory Animal Testing: What Can We Learn?" Sage Journals, journals.sagepub.com/doi/full/10.1177/02611929221118001.

However, when scrutinizing social factors, such as rapid scientific development, moral factors, such as the moral standing of an animal, clash with them. In order to find plausible and effective solutions, it is crucial to find the balance between progress and ethical decisions.

It has been observed that animal testing in the medical field is considered more ethical than that in the cosmetic field. On the one hand, medical research also focuses on the general improvement of human health and the development of cures for diseases, such as cancer, with extremely complicated procedures performed on animals that cannot be replaced so easily. These experiments, seeing as the health and wellbeing of humans is highly regarded in society, are regarded as crucial for survival. Furthermore, the ethical considerations in this field reach both humans and animals, seeing that many medicines that pass regulatory tests, which were conducted on animals, fail to have the same effect on humans. This, in turn, firstly begs the question of whether it is ethical and accurate to use animals for such important research, and secondly, what could happen to humans exposed to falsely verified medicine.

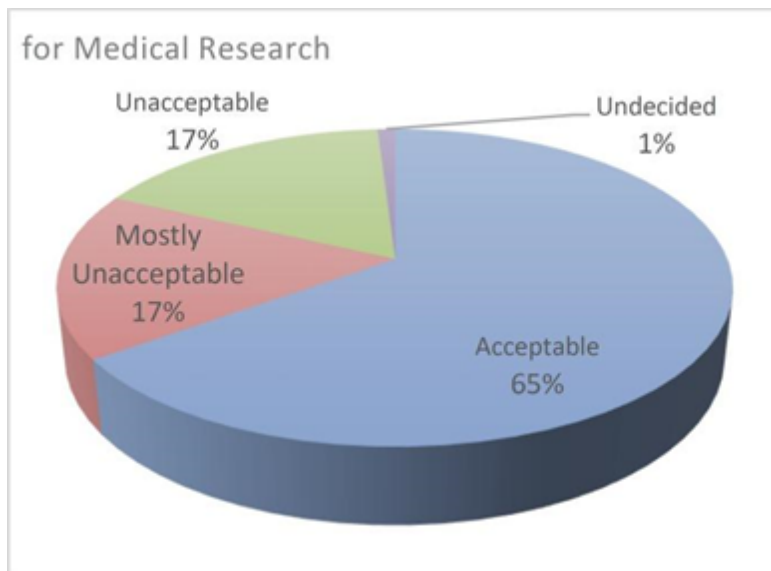


Figure 3: Animal testing acceptability for medical research²³

On the other hand, cosmetology, as per definition, is a field that focuses on enhancing human beauty. Some argue that this field of research has no justification for using animals, not only because it is regarded as secondary, but also because it is much easier to replace the testing procedures with NAMs

²³ "Bioethics: a Look at Animal Testing in Medicine and Cosmetics in the UK." PubMed Central (PMC), www.ncbi.nlm.nih.gov/pmc/articles/PMC7166243/.

or in vitro practices. Moreover, the value, rights and treatment of animals is a central concern because the legal regulations of animal testing in cosmetology are less severe than those in pharmaceuticals.

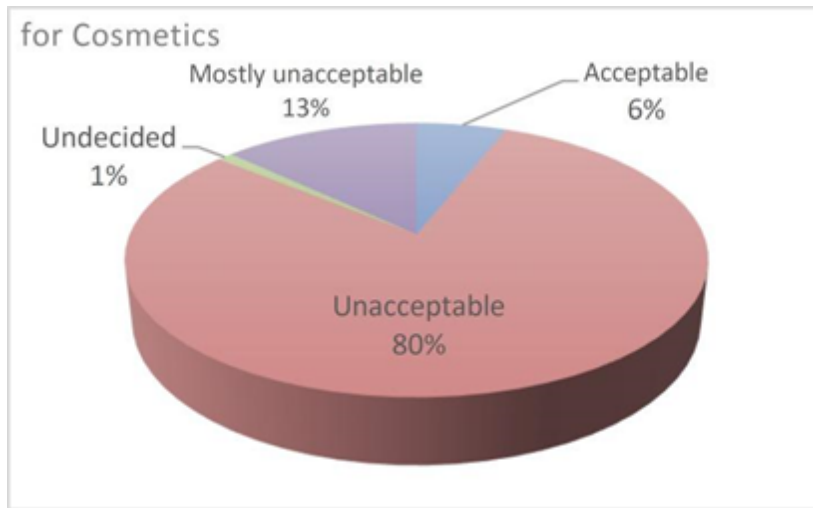


Figure 4: Animal testing acceptability in cosmetology²⁴

Both fields, however, have been faced with accusations of torture and exploitation of the animals they use in research. Questions regarding the proper training of personnel have sparked heated debate, seeing as animal testing is widely regarded as unethical. Aside from ethical concerns, the difference between human and animal biology has led to doubts regarding the application of test results on humans. Nevertheless, animal testing has contributed not only to advancements in the medical and general research field for humans, but also has led to the creation of numerous treatments that improve animal health.

MAJOR COUNTRIES AND ORGANISATIONS INVOLVED

United States of America (USA)

The USA, to this day, has the largest contribution to research-related animal testing, with an average of 100 million animals being tested²⁵ annually. The US Food and Drug Administration (FDA) does

²⁴ "Bioethics: a Look at Animal Testing in Medicine and Cosmetics in the UK." PubMed Central (PMC), www.ncbi.nlm.nih.gov/pmc/articles/PMC7166243/.

²⁵ Gray, Elizabeth. "20 Animal Testing Statistics You Need to Know in 2024." Animal World, 19 Feb. 2024, animal-world.com/animal-testing-statistics/.

conduct investigations regarding the ethical use of animals in pharmaceutical products and regular tests of the drugs on humans, though they have not yet placed a ban on animal testing as some practices are allowed. The USA has established many laws on animal testing, such as the Animal Model Qualification Program, to ensure it is used ethically. Moreover, there has been an attempt to amend the Animal Welfare Act of 1966 to include all animals under its protection.

People's Republic of China (PRC)

The PRC was one of the first countries to use animal testing to progress in the medical field. This practice dates to the early days of medicine where herbs and natural treatments were tested on animals to ensure their safety before being given to and consumed by humans. Nowadays, the PRC is the second largest contributor to animal use in research-related testing²⁶, having used over 15 million animals in one year. Regarding the public's opinion on these actions, it is safe to say that views are very polarized, with the proposition advocating for progress and the opposition questioning ethics. Be that as it may, as a major contributor to the medicinal field, the PRC makes collaborative, international efforts, such as being an active member of Humane Society International's (HSI) "Be cruelty-free" campaign, to completely ban animal testing.

Japan

It has been observed that Japan, mostly for religious and moral reasons, presents a culture against animal testing and cruelty. Despite this fact, according to the World Animal Protection Index (WAPI), Japan is one of the lowest-ranking countries when it comes to the protection of animals in all fields, gaining minimum points in the research and scientific area. Seeing as the situation worsened as of 2020, having used just over 10 million animals for research purposes²⁷, the Animal Welfare Act (AWA) was passed in 2024 in collaboration with Humane Society International (HSI) in hopes of lowering the number of animals used for testing in laboratories.

²⁶ "Animals Used in Research Experiments Worldwide by Country 2020." *Statista*, 30 Apr. 2021, www.statista.com/statistics/639954/animals-used-in-research-experiments-worldwide.

²⁷ "Animals Used in Research Experiments Worldwide by Country 2020." *Statista*, 30 Apr. 2021, www.statista.com/statistics/639954/animals-used-in-research-experiments-worldwide.

India

Although the conditions in which animals are being tested upon are non-ideal, India places high when it comes to accountability, and animal protection, especially in the scientific field and laws against animal suffering. As the first South Asian country to place a complete ban on animal testing in 2014, its industry places great emphasis on aiming for animal welfare and being cruelty-free by, for example promoting the consumption of cruelty-free products. However, India has refrained from showing direct support for any international legislation, treaties or events regarding animal protection and welfare.

Cruelty Free International

In 1898 anti-vivisection and animal rights activist, Frances Power Cobbe Click here to enter text. founded Cruelty Free International with the aim of raising awareness about animal testing and protesting it. Ever since then, Cruelty Free International has dedicated itself to campaigning and ending all forms of animal testing globally. Aside from protests and investigations, the organization has developed a “Cruelty Free Science” team that evaluates and assesses medicine, cosmetics and products, seeing as many of them use outdated animal tests and results just to abide by legal guidelines. Thus, the international community is called upon to recognize new alternatives to animal testing while also strengthening already existing regulations and guidelines.

People for the Ethical Treatment of Animals (PETA)

People for the Ethical Treatment of Animals (PETA) is an organization founded on March 22nd, 1980, and is currently being led by Ingrid Newkirk, a British-American animal activist. Based in Norfolk, Virginia, this organization focuses on achieving the ethical treatment of animals in four areas, namely, laboratories, the entertainment, clothing and food industries by means such as protesting, animal rescue, donations and investigations. With over 9 million members worldwide, PETA aims to abolish speciesism and follow the principle that animals should not be used or abused in any way, shape or form for the sake of humans. Despite the controversies surrounding high euthanasia rates, PETA has managed to successfully pass petitions and pass legislations, such as the “FDA Modernization Act 2.0 ”²⁸ which involved the Food and Drug Administration (FDA) recognizing and promoting non-animal research in pharmaceuticals and research

²⁸ "S.5002 - FDA Modernization Act 2.0." congress.gov, www.congress.gov/bill/117th-congress/senate-bill/5002.

Humane Society International (HSI)

Ever since its founding in 1919, Humane Society International has dedicated itself to the protection and welfare of all animals. Their work revolves around stopping animal testing and cruelty, but also implementing legislative guidelines. [08] On their website, HSI grants access to information and insight into topics such as biomedical research or ongoing legislation shifts, they are aiming towards, that would otherwise go unnoticed by the public. Aside from donations, the organization hosts and sponsors campaigns against animal cruelty, thus involving the public in fighting for the cause²⁹.

World Animal Net

Established in 1997, the World Animal Net (WAN) has become one of the largest and most significant organizations with regard to animal protection. This organization partners with 100 countries and over 3000 experts and consultants with the goal of collaborating with and promoting global campaigns that advocate for change in the field of animal use for pharmaceutical and cosmetic purposes. With a focus on quality research and effective collaboration, the WAN strives for the more considerate and ethical treatment of animals globally.³⁰

²⁹ Humane Society International, 16 Nov. 2023, www.hsi.org/.

³⁰ World Animal Net. "About Us." World Animal Net, worldanimal.net/about. Accessed 16 July 2024.

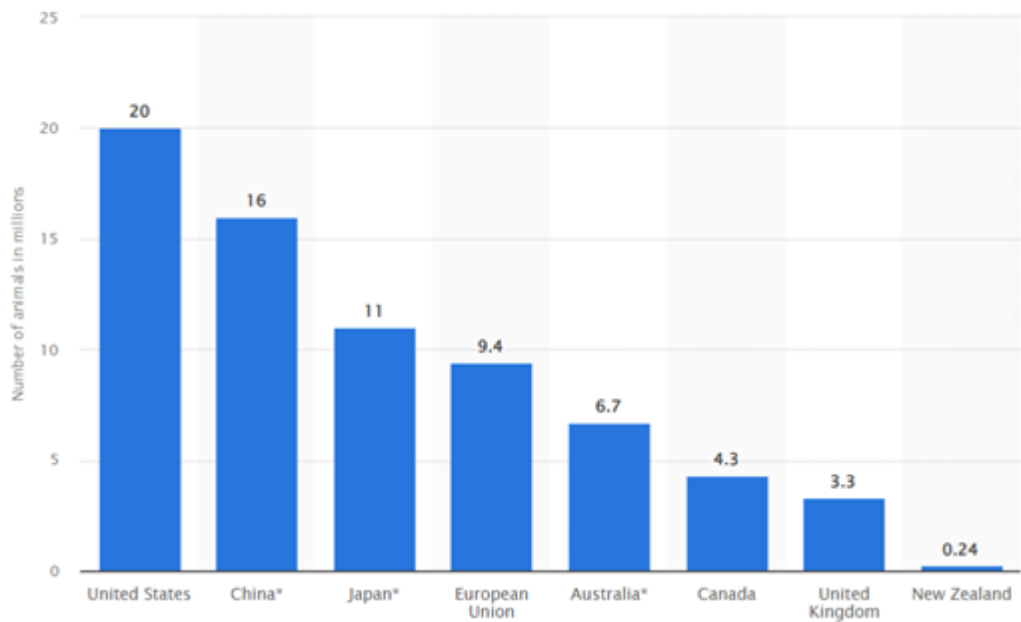


Figure 3: Number of animals used in research and testing in selected countries (2022)³¹

TIMELINE OF EVENTS

| Date | Description of Event |
|---------------|--|
| Antiquity | First recorded tests on animals in Ancient Greece, Rome and China |
| 1898 | Cruelty Free International (CFI) is founded by animal activist Frances P. Cobbe |
| 1919 | Humane Society International (HSI) is founded for animal welfare |
| 1975 | Philosopher P. Singer publishes "Animal Liberation" |
| 22 March 1980 | People for the Ethical Treatment of Animals (PETA) is founded in Norfolk, Virginia |

³¹ Statista.

<https://www.statista.com/statistics/639954/animals-used-in-research-experiments-worldwide>.

| | |
|-------------------|--|
| 1983 | Philosopher T. Regan publishes “The Case Study on Animals” |
| 1997 | The World Animal Net (WAN) is founded |
| 2010 | The EFPIA and EU redefine and officially implement the “Three Rs” principle |
| 2016 | The “Guidelines for Research Ethics in Science and Technology” are established |
| 2019 | The UN Convention on Animal Health and Protection (UNCAHP) is established |
| 13 April 2022 | Adoption of the UNEP/EA.5/RES.1 by the UN Environmental Assembly in Nairobi, Kenya |
| 2022 | The EFPIA conducts the 2022 Pharmaceutical Industry Report Update |
| July 2023 | The EPAA NAM Designathon takes place |
| 20 –22 March 2024 | The EPAA creates and publishes the NAM Designathon Flash Report |
| 2029 | Deadline of mandatory implementation of the UNCAHP for all Member States |

UN INVOLVEMENT: RELEVANT RESOLUTIONS, TREATIES AND EVENTS

UN Convention on Animal Health and Protection (UNCAHP)

The UNCAHP is a globally implemented legislation that legally binds all member states of the United Nations (UN). With a total of 16 articles drafted in collaboration with the Global Animal Law (GL) Association, the convention aims for the global protection, health and respect towards all animals. The UN General Assembly adopted this convention in 2019 and, albeit for it to be treated as a treaty, this legislation will only be fully implemented in 2029. Nevertheless, almost all member states have shown their full support towards the legislation, raising the chance of full implementation before the deadline.

Resolution 5.1 of the United Nations Environmental Programme on animal welfare

The United Nations Environmental Programme (UNEP) resolution was adopted by the United Nations Environment Assembly, Nairobi 2022: This resolution calls upon the Executive Director of the UNEP to submit a report alongside other UN bodies and organizations, such as the World Organization for Animal Health (WOAH), responsible for improving animal welfare through international collaboration and support, and the United Nations World Health Organization (WHO), which will analyze actions taken towards animal welfare with regards to environmental and sustainable development. The two organizations the UNEP partnered with have both played a significant role in achieving animal health and welfare through legislations and methods, such as disease control or the promotion of the responsible use of antibiotics. The report was presented during the sixth session of the United Nations Environmental Assembly (UNEA), however there has been no further information from the Animal Welfare Environment and Sustainable Development (AWESDE) Nexus Steering Group, which was established to aid in the creation of the report, about whether the resolution has been fully implemented.

PREVIOUS ATTEMPTS TO SOLVE THE ISSUE

European Foundation for the Right of the Living World (EFRLW)

The European Foundation for the Rights of the Living Worlds, founded by José-Javier Paniagua in Belgium, aims for the global recognition of animal and ecosystem rights. Alongside the Global Animal Law (GAL) Association, the EFRLW documents and promotes various European and global legislations through its digital database. Examples of implemented include the “International Standards of the World Organization for Animal Health”³², focusing on animal welfare on land and in the ocean, and “European Convention for the Protection of Vertebrate Animals used for Experimental and other Scientific

³² "Database Legislation." Global Animal Law GAL Association, www.globalanimallaw.org/database/international.html. Accessed 16 July 2024.

Purposes"³³. However, as this foundation operates on a European level, it renders its accuracy and effect on global animal laws doubtful.

Guidelines for Research Ethics in Science and Technology

A set of guidelines created by the Norwegian National Committee for Research Ethics in Science and Technology under the National Research Ethics Committees in 2016³⁴, this legislation follows many aspects with regard to animal cruelty during research. It provides detailed explanations in sectors such as accountability, responsibility and transparency in science and the protection of animals used in testing with regards to the importance of scientific research for progress. Despite this fact, these guidelines were created years before they were published, during a time when a surge in technological advancement and scientific breakthroughs was witnessed, making the researchers and scientists question their accuracy and effect in the future.

PETA2

PETA2 is a program created by the PETA organization. With this action, PETA encourages children and teenagers to participate in ending animal cruelty by engaging in activities and providing support to the cause. Support can be provided by means such as participating in courses, joining and promoting campaigns in one's region or simply buying stickers from the program's online website. This way, the youth is not only actively involved in banning animal testing, but also given the opportunity to engage and collaborate with each other.³⁵ Be that as it may, seeing as the founding organization for PETA2, PETA, has used many controversial means to spread their message, such as extensive cases of euthanasia, which resulted in a lawsuit³⁶, this begs the question of whether or not children and teenagers should be exposed to such radical means of protest.

³³ Council of Europe. "Full List." Treaty Office, www.coe.int/en/web/conventions/full-list?module=treaty-detail&treaty-num=123. Accessed 16 July 2024.

³⁴ "Guidelines for Research Ethics in Science and Technology." *Forskningsetikk*, 7 Aug. 2019, www.forskningsetikk.no/en/guidelines/science-and-technology/guidelines-for-research-ethics-in-science-and-technology/.

³⁵ "Get the Latest Ways to Help Animals." Peta2, 8 July 2024, www.peta2.com/?en_txn7=Home-Featured%3A%3Ahomepage-peta2-vertical-boxu0026p2asource%3DHome-Featured%3A%3Ahomepage-peta2-vertical-box.

³⁶ "Animal Advocates Cheer As Bill Aimed At High-Kill PETA Shelter Is Signed Into Law." *HuffPost*, 26 Mar. 2015, www.huffpost.com/entry/peta-shelter-virginia-bill-sb-1381_n_6942866.

POSSIBLE SOLUTIONS

In chemico and in silico research

Understanding the effect of the drug's interaction with non-biological molecules, such as proteins, and biological macromolecules, such as DNA, is vital for ensuring the safety of consumers after the drug's release. In chemico research is a physicochemical measurement process that measures a drug's reactivity without making use of in vivo specimens. Oftentimes it is strategically connected with in silico research to immediately recognize and measure a drug's reactivity and toxicity levels, both requirements in international guidelines, such as the Good Laboratory Practice and the Animal Welfare Act. Through the immediate collection and assessment of data from recorded reactions, scientists successfully managed to not only achieve results without consulting in vivo specimens but also release safer medicine. However, without the recognition of the international scientific community and strategies or legislations regarding their safe and effective use, the implementation of these methods as alternatives to animal testing is hindered.

Computer-generated and mathematical models

Technology has constantly been evolving, giving us the chance to experiment with its abilities further. Nowadays, researchers have managed to create models that replicate parts of the human body, such as the heart or liver. Using data gathered from numerous research cites and experience, these models can generate precise and accurate reactions that the human body shows towards certain stimuli, in this case, medicine and toxins. The creation of various, more advanced models that can predict and simulate human-like reactions will aid in progressing in this field of research whilst providing an alternative to animal testing. Having said that, for these models to function and be as accurate as needed, adequate data from human specimens must be collected and integrated into the systems. Furthermore, despite their proven level of accuracy, with the intense complexity of living organisms, the possibility for the exact replication of every possible reaction decreases.

In vitro studies

In recent times, in vitro studies have become increasingly popular amongst researchers as they do not require in vivo specimens to easily produce results. Conducted in lab equipment, such as petri dishes or test tubes, they usually take a more toxicological approach when it comes to assessing drugs,

allowing for the calculation of toxin levels and chemical reactions. In vitro research is, as per definition, conducted on cells and tissue outside of the body, resulting in questions regarding its plausibility. Apropos plausibility, the strong need for resources and technical skills in the development of in vitro models limits their use in modern pharmaceuticals. The recognition of the models' efficiency and accuracy and further advancements in their development are two necessary steps for the implementation of in vitro studies as an alternative to animal testing. Nevertheless, in vitro research has allowed for advancements in biochemistry and toxicology and, consequently in pharmaceuticals as well.

Organs-on-a-chip (OoAC)

The "organs-on-a-chip", a recent scientific breakthrough, has allowed researchers and scientists to generate almost the exact reactions of human organs when tested upon. The reactions are held on and recorded on a microfluidic chip that can later be transferred into data. When combined with cell cultures, a recreation of human and animal cells in laboratories, these chips can further our understanding of the reactivity of a human's body towards drugs, toxins and chemicals. With the ability to recreate both human and animal cells and their exact reactions, we can turn away from animal testing while progressing in the testing of chemical safety. Keeping in mind that scientists are focusing on replicating multiple organs on one chip, creating a "human-on-a-chip", it is important to remember how complex and challenging it is to create these chips, because, for example, human tissue, thus its replica as well, are very fragile. This, in turn, it calls for development and international collaboration to give easier access to resources, data and technical knowledge.

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