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THE ROLE OF LABORATORY ANIMALS IN SCIENTIFIC RESEARCH

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Abstract: Many medical advancements that improve human life are based on laboratory animal research studies. Scientists carefully and thoughtfully select and justify the specific animal models used in their research, adhering to current legal requirements, the principles of the 3 R's (reduction, reuse, and refinement), and ensuring that animals are used only when no other research solution is feasible or available.



Mouse (*Mus musculus*)

https://upload.wikimedia.org/wikipedia/commons/7/73/Lab_mouse_mg_3140.jpg

• Introduction

For more than a century, laboratory animals have been of invaluable help on growing our scientific understanding and for achieving major medical advances.

For example, many researches in the field of osteosynthesis of fractures, development of new materials with biological interest, drugs used in chemotherapy, the usage of stem etc., have hugely benefited from animal experimentation

Even though there are continuous ethical discussions and nowadays more alternative techniques are available, laboratory animals are still a vital part of biomedical research.

• Material and method

We search on MEDLINE (PubMed), Google Scholar, Web of Science and Researchgate platforms, with keywords as: "use of" and "laboratory" and "animals" or "3R" or "animal models" and "zebrafish" and applying filters such as: papers no older than 10 years, text availability as abstracts and full papers without other restrictions such as language. As results we had over 20 000 papers showed, selected over 100, and used only 53.

• Results and discussions

* The most commonly used animal models in biomedical research for decades have been rodents, mainly: mice, rats, hamsters and guinea pigs. This is due of a number of variables and factors, including the fact that they are biologically comparable to humans, the ease of keeping, breeding and usage in laboratories in a variety of studies such as: obesity, Parkinson's disease, stroke, aging etc.

* Rats have a higher ability for cognition in comparison to mice, making the rat an ideal candidate for psychological studies involving behavior, learning and cognition.

* Guinea pigs have a unique position between rodent models, especially in human immunology studies. Their immune system is quite similar to humans rather than of mice, and based on this consideration they are preferred in testing vaccines and biodefense agents

* Due to high genetic resemblance to us, humans, zebrafish, *Danio rerio*, have become the second most common animal model used in laboratory, sharing almost 70% of protein-coding genes. Moreover, approximately 84% of known genes associated with some diseases in humans also have an analogue in zebrafish and they reproduce fast, lay hundreds of clear eggs externally.

* *Xenopus* frogs, especially *Xenopus laevis* (African clawed frog) and *Xenopus tropicalis* (Western clawed frog), are new and widely adopted animal model in biomedical research because of their genetic resemblance with humans and there have been some estimation that almost 80% of diseases from humans could find an equivalent in *X. tropicalis*.

* The use of animals in scientific research is closely guided on an ethical level by the world-wide accepted principles known as 3Rs (Replacement, Reduction, and Refining)

* In Europe, the care and use of laboratory animals in scientific research is governed and regulated by a strict legal and ethical framework: EU Directive 2010/63/EU and in Romania by Law 43/2014 and under the supervision of NASVFS (ANSVSA).



Zebrafish vivarium at University of Cambridge
(original photo)



African clawed frog (*Xenopus laevis*)
https://www.mun.ca/biology/scarr/Xenopus_frogchain.jpg



Zebrafish larvae (*Danio rerio*)
Original photo taken at University of Cambridge

Conclusions

- Major emphasis on finding, developing and adopting of new alternatives as animal models, software and even hardware component that can mimic tissues and organs.
- Refining the 3Rs concepts should be a commitment, as well as searching for other non-animal alternatives and the selection of the appropriate animal model for exact type of research
- Continuous technological advancements and research hold the promise of further reducing our reliance on animal models while maintaining the essential pace on scientific discovery that will benefits all the living beings.

Table 1. Advantages and disadvantages of como animal models
adapted after: Wheeler, G. N., & Brändli, A. W. (2009)

Category:	C. elegans	Drosophila	Zebrafish	Xenopus	Chicken	Mouse
Brood size	250-300	80-100	100-200	500-3000+	1	5-8
Cost / embryo	low	low	low	low	medium	high
Access to embryos	good	good	good	good	poor	poor
Micro-manipulation of embryos	limited	limited	fair	good	good	poor
Genetics	good	good	good	fair	none	good
Knockdowns (RNAi, morpholinos)	good	good	good	good	limited	limited
Transgenesis	good	good	good	good	poor	good
Evolutionary distance to human	very distant	very distant	distant	intermediate	intermediate	close

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