

Invited Editorial

Alternatives for Animal Testing: A More Humane Approach To Clinical Research

Santosh Kumar ¹ , Namrata Dagli ² , Mainul Haque ^{3 a, b} 

Keywords: Way Out, Animal Experimentation, Animal Research, Supplementary, Civilized, Animal-Friendly, Perspective, Technique, Clinical Trials, Clinical study

Bangladesh Journal of Medical Science Vol. 22 No. 03 July'23 Page : 472-474
DOI: <https://doi.org/10.3329/bjms.v22i3.66959>

Till today, animal studies precede clinical trials to establish the safety and efficacy of novel drugs. Animal testing not only involves animal cruelty but also produces unreliable results ¹. Many scientists and researchers have questioned the reliability of animal studies in recent years. Animals differ significantly from humans in their physiological, genetic, and behavioral characteristics, which makes the animal study results unsuitable to be extrapolated to humans with certainty. Furthermore, animal studies are poorly designed and often conducted in controlled environments that do not reflect the complexity of human physiology ². Relying excessively on animal studies to guide medical research and treatments can be misleading. Therefore, it is vital to explore, validate and adopt alternative methods that are more reliable and humane.

The significant advancement in science and technology has opened new doors and opportunities

in every area of life, including research, enabling us to explore alternative methods. One of the alternatives to animal testing is in-vitro methods. Compared to traditional in-vitro methods such as cell cultures, advanced techniques such as organ-on-a-chip systems are far more efficient for research. Organ-on-a-chip is a bio-engineered miniature 3D tissue model that mimics the structure and function of the actual human organs. The tissues are grown inside microfluidic chips that simulate the structure and function of a human organ. These devices allow researchers to study organogenesis, drug interaction, and the effect of various chemicals on human organs without using animal models or human subjects ^{3, 4}. These methods provide a rapid alternative to animal testing and produce more reliable and reproducible results. Besides being a more humane approach, the other main advantage of these in-vitro methods over animal testing is that they can provide insights

1. Department of Periodontology, Karnavati School of Dentistry, Karnavati University, Gandhinagar, Gujarat 382422, India.
2. Adjunct Research Faculty, Center for Transdisciplinary Research, Saveetha Dental College and Hospital, Saveetha Institute of Medical and Technical Sciences, Chennai, Tamil Nadu 600077 India.
3. ^aUnit of Pharmacology. Faculty of Medicine and Defence Health, Universiti Pertahanan Nasional Malaysia (National Defence University of Malaysia), Kem Perdana Sungai Besi, 57000 Kuala Lumpur, Malaysia. ^b Professor and Research Advisor, Department of Scientific Research Center (KSRC) Karnavati School of Dentistry, Karnavati University, Gandhinagar, Gujarat-382422. India.

Correspondence

1. **Santosh Kumar.** Department of Periodontology and Implantology, Karnavati School of Dentistry, Karnavati University, Gandhinagar, Gujarat, India. Email: drsantoshkumar2004@gmail.com. Cell Phone: +91 96018 00379.
2. **Mainul Haque.** ^aUnit of Pharmacology. Faculty of Medicine and Defence Health, Universiti Pertahanan Nasional Malaysia (National Defence University of Malaysia), Kem Perdana Sungai Besi, 57000 Kuala Lumpur, Malaysia. Email: runurono@gmail.com, mainul@upnm.edu.my. Cell Phone: +60109265543.

into human-specific responses, often not accurately reflected in animal studies ⁵.

Another alternative is computer modeling and simulation. Advanced computational techniques enable researchers to develop virtual models that simulate biological processes, drug interactions, and toxicological effects. Computer modeling and simulation may be invaluable in accelerating the research process and reducing the reliance on animal studies for obtaining safety data on any novel drug ⁶.

Other emerging alternatives to animal testing are micro-dosing and micro-sampling. Micro-dosing involves administering small doses of substances well below those expected to affect the whole human body. Micro-sampling is a technique that involves collecting small samples of tissues for analysis. These methods enable researchers to study human-specific responses. These non-invasive techniques can be used to gain valuable insights into human pharmacokinetics, metabolism, and safety profiles of substances ⁷.

Human-based research methods are particularly relevant when studying diseases or conditions that are unique to humans or have complex human-specific factors. In such cases, these methods are irreplaceable with animal testing. Despite several limitations, such as ethical considerations and potential variability among human populations, human-based research methods are crucial in bridging the gap between animal studies and human health. Thus, instead of sacrificing animals for studies that often provide unreliable results, it is better to focus on finding techniques that offer more human-specific data. This can also help reduce the need for redundant animal testing. Researchers can also utilize existing data and literature reviews to gather data from published scientific literature and databases for relevant information about their research. The wealth of existing knowledge can help avoid unnecessary repetition of animal studies, which may not produce any novel or valuable results.

While these alternative methods show great promise, further research and validation are still needed to ensure these methods' accuracy, reliability, safety, and applicability. Additionally, the concerns regarding the cost, availability, and practicality of

implementing these alternatives in particular research areas or industries must be addressed ⁸.

In conclusion, we must adopt a more humane research approach and not rely on traditional animal testing methods. We must explore advanced technology to find more ethical, reliable, and valid techniques to viably replace or reduce the reliance on animals in research and testing. Promising alternatives, such as organ on a chip, computer modeling and simulation, human-based research methods, micro-dosing, and micro-sampling, can provide reliable and relevant results while avoiding the ethical concerns and animal cruelty associated with animal testing. To advance more compassionate, rigorously scientific, and pertinent research practices consistent with ethical research and human health principles, the scientific community, policymakers, and stakeholders must work together and prioritize developing, validating, and adopting these alternatives.

Consent for Publication

The author reviewed and approved the final version and has agreed to be accountable for all aspects of the work, including any accuracy or integrity issues.

Disclosure

The author declares that they do not have any financial involvement or affiliations with any organization, association, or entity directly or indirectly with the subject matter or materials presented in this editorial. This includes honoraria, expert testimony, employment, ownership of stocks or options, patents, or grants received or pending royalties.

Data Availability

Information is taken from freely available sources for this editorial.

Authorship Contribution

All authors contributed significantly to the work, whether in the conception, design, utilization, collection, analysis, and interpretation of data or all these areas. They also participated in the paper's drafting, revision, or critical review, gave their final approval for the version that would be published, decided on the journal to which the article would be submitted, and made the responsible decision to be held accountable for all aspects of the work.

References

1. Akhtar A. The flaws and human harms of animal experimentation. *Camb Q Healthc Ethics*. 2015;**24**(4):407-19. doi: 10.1017/S0963180115000079.
 2. Bracken MB. Why animal studies are often poor predictors of human reactions to exposure. *J R Soc Med*. 2009 ;**102**(3):120-2. doi: 10.1258/jrsm.2008.08k033.
 3. Leung CM, De Haan P, Ronaldson-Bouchard K, Kim GA, Ko J, Rho HS, Chen Z, Habibovic P, Jeon NL, Takayama S, Shuler ML. A guide to the organ-on-a-chip. *Nat Rev Methods Primers*. 2022; **2**: 33. doi.:10.1038/s43586-022-00118-6.
 4. Wu Q, Liu J, Wang X, Feng L, Wu J, Zhu X, Wen W, Gong X. Organ-on-a-chip: recent breakthroughs and future prospects. *Biomed Eng Online*. 2020;**19**(1):9. doi: 10.1186/s12938-020-0752-0.
 5. Singh D, Mathur A, Arora S, Roy S, Mahindroo N. Journey of organ on a chip technology and its role in future healthcare scenario. *Applied Surface Science Advances*. 2022;**9**:100246. doi: 10.1016/j.apsadv.2022.100246.
 6. Badyal DK, Modgill V, Kaur J. Computer simulation models are implementable as replacements for animal experiments. *Altern Lab Anim*. 2009;**37**(2):191-5. doi: 10.1177/026119290903700208.
 7. Burt T, Young G, Lee W, Kusuhara H, Langer O, Rowland M, Sugiyama Y. Phase 0/microdosing approaches: time for mainstream application in drug development? *Nat Rev Drug Discov*. 2020;**19**(11):801-818. doi: 10.1038/s41573-020-0080-x.
 8. Singh VP, Pratap K, Sinha J, Desiraju K, Bahal D, Kukreti R. Critical evaluation of challenges and future use of animals in experimentation for biomedical research. *Int J Immunopathol Pharmacol*. 2016;**29**(4):551-561. doi: 10.1177/0394632016671728.
-