

2023 PSBR Middle School Essay Contest
First Place

Divyanshu S.

Julia R. Masterman School
Philadelphia, PA

Ah, biomedical research. The field of study which helps everyone learn about how the human body functions to develop cures and treatments. It almost seems like magic. Learning about what is happening inside our bodies, where we cannot see. Unsurprisingly, biomedical research has saved millions of lives, especially during pandemics. For example, the Covid vaccine was a form of biomedical research.

Biomedical research involves three stages: basic, applied, and clinical. Basic research aims to increase knowledge of how human and animal bodies work. Applied research builds upon this knowledge to achieve specific goals, such as developing new medicines (both curative (e.g; cell and gene therapy) and prophylactic like vaccines, etc), diagnosing diseases, or creating new technologies. Clinical research involves pre-clinical trials on non-human animal models (rodents, fishes, cats, dogs, birds, primates, etc.), followed by clinical trials on humans to evaluate the safety and effectiveness of new treatments. Clinical trials are conducted in hospitals and medical centers. The aim of biomedical research is to improve human health through the discovery of new treatments, medicines, and technologies.

Some commonly used animals in biomedical research are mice, rats, and other rodents. These make up 90-95% (more than 150 million) of the animals used in biomedical research in the USA alone. Their bodies work similar to the body of human beings. Their lifespan is also quite short, allowing them to be studied for the entirety of their life. This also makes it easy to study the next generation of the rodents. Rodents are also used due to their ability to reproduce greatly in a short amount of time. They can be genetically modified which helps to understand and cure genetic disorders. They are cheap, small, and can be controlled very easily. Other types of animals can be used in biomedical research are cats, dogs, pigs, non-human primates (NHPs). NHPs consist of less than ¼ of a percent of animals used in biomedical research. These are used due to their similarities to humans. However, it is a little harder to control them.

In order to have control on the number of animals used in research and act responsibly and humanely, the concept of the three R's was created. Reduction, Replacement, and Refinement. Replacement: going for alternatives that avoid or replace animals for a test such as computer simulations, using animal mannequins and dummies to train students, videos of surgical procedures for teaching, using smaller animals in lieu of primates etc. Reduction: the process of using less animals to still obtain sufficient data and not use excessive animals as that is economically wasteful. Refinement: modifying the experiments and procedures on the animals such that they feel minimum pain and distress and handle them humanely.

Alternative methods to animal models in biomedical research include in vitro studies, computer modeling, and organ-on-a-chip technology. In vitro studies involve growing cells in a controlled environment. Computer modeling simulates biological systems. Organ-on-a-chip technology replicates human organs using miniature devices. These alternatives provide more accurate and ethical results, reduce animal testing, and improve the efficiency of research. Human volunteers can also be used instead of animals in a clinical trial. These volunteers cannot be exploited or put in an unsafe position. Whatever happens to the humans must also remain confidential and private.

Epidemiological studies center around diseases that impact human populations, with current attention on the Covid pandemic which has affected the entire globe. These studies aid in comprehending the disease's transmission, preventative measures, symptoms, and potential risks. Epidemiological studies can help inform public health policies and interventions, such as disease prevention strategies, vaccination campaigns, and outbreak response plans.

Despite the valuable contributions made by biomedical research, it is clear that there is still much more to be discovered. Biomedical research has contributed significantly to the development of life-saving vaccines, cures for various diseases, cancer-fighting drugs, and the recent Covid vaccines have been the most significant achievements in the field.

Looking towards the future, biomedical research has a pressing need to develop a drug capable of completely eradicating Covid, which has affected millions worldwide. Additionally, the urgent need to cure cancer remains a top priority, as many have suffered the loss of loved ones to this disease. While there are still challenges to overcome, biomedical research remains crucial in improving human health and saving lives. It is essential that regulations continue to evolve to ensure the ethical treatment of animals in research and that alternative methods continue to be explored to reduce animal testing and improve research efficiency.

Bibliography

“Fact vs. Myth.” *Foundation for Biomedical Research*,

https://psbr.org/images/Educational_Materials/fbr_fact_vs_myth.pdf. Accessed 23 Feb. 2023.

“Fact Sheet - What is Biomedical Research?” *California Biomedical Research Association*

https://psbr.org/images/Educational_Materials/cbra_factsheet_biomedical_research.pdf Accessed 24 Feb. 2023.

“Animal Research is Necessary for Medical Progress.” *Americans for Medical Progress*,

https://psbr.org/images/Educational_Materials/amp_facts_about_research.pdf. Accessed 23 Feb. 2023.

“The Essential Need for Animals in Medical Research.” *Foundation for Biomedical Research*,

https://psbr.org/images/Educational_Materials/fbr_essential_need_species_sheets.pdf. Accessed 22 Feb. 2023.

“The Use of Animals in Biomedical Research: Improving Human and Animal Health.” *American Association for Laboratory Animal Science*,
https://psbr.org/images/Educational_Materials/aalas_improve_human_animal_health.pdf. Accessed 8 Mar. 2023.

“Ethics of Human Testing.” *National Institutes of Health*
<https://pubmed.ncbi.nlm.nih.gov/16032818/>. Accessed 6 Mar. 2023.

“What is Epidemiology?” *Centers for Disease Control and Prevention*
<https://www.cdc.gov/careerpaths/k12teacherroadmap/epidemiology.html>.
Accessed 5 Mar. 2023.