

2024 PSBR Middle School Essay Contest
1st Place

Faye M.
The Episcopal Academy
Newtown Square, PA

What is Biomedical Research?

Biomedical research is a field of science that allows people to understand more about functions of the human body and develop treatments for diseases. Individuals from both the life and physical sciences contribute unique skills to research teams. These specialists are usually medical doctors, computer scientists, technicians, researchers, veterinarians, and others who work in sciences.

The three main stages of biomedical research are basic, applied, and clinical research. Basic research happens first, and increases scientists' knowledge about both the fundamentals of science, and about processes and functions within living things. Applied research is used for specific medical goals and discoveries, such as diagnosing disease, creating medications, and building devices. It uses the information from basic research, and adds onto the knowledge to solve the specific problem. The last stage, clinical research, includes pre-clinical trials on non-human animal models, which allow researchers to perform irreplaceable tests that show the complex processes in a whole organism. These trials test and check the effects and safety of the developed drugs, medical devices, or procedures. Clinical trials follow, which are performed in hospitals or clinical settings with human volunteers. Clinical trials are done in phases, coordinated and approved by the U.S. Food and Drug Administration (FDA).

Animals play a necessary and important role throughout the whole process of biomedical research. In vivo (Latin for "in the living") studies must be done in living organisms. Newly developed treatments must be tested on animals before being exposed to humans (pre-clinical trials). It would be illegal, unethical, and much harder to use humans in early stages of research. Animals are also similar to humans on a biological level, and some have shorter life spans, so they can be studied throughout their whole lives, and even through multiple generations. Bred rats and mice are most commonly used, and make up more than 95% of all laboratory animals. Mice and rats have similar genetic makeups to humans, which are close enough for researchers to gather lots of information from studying them. Other animals such as dogs or nonhuman primates are much less common. Using animals also allows scientists to control factors in the environments around the animals (diet, lighting and temperature) more easily than with humans.

Even though animal models may be helpful, researchers try to remain ethical with animals, and abide by the three Rs (Reduction, Refinement, Replacement). Reduction means to use methods that obtain necessary knowledge while using less animals. Refinement refers to the animals' treatment, and means using more effective anesthetics and analgesics, suitable housing for each species, and many enrichment activities. Replacement means using methods that don't involve a whole animal, including cultures and computer models.

There are also methods of research that avoid using animal models. In vitro (Latin for “in the glass”) studies are done in laboratories, are studies of cell, bacteria, tissue and organ cultures. Ex vivo (Latin for “out of the living”) studies are experiments done in a laboratory on living cells from an organism cultured in an apparatus which models the complete organism. In silico (Latin for “in silicon”) studies are simulations done in computers. These computer models can show functions of living organisms and aid scientists in their research, but the results still must be verified again in the real world.

Epidemiology is a section of biomedical research about the distribution, causes, prevention and control of diseases among a population. It helps show how certain people who share specific characteristics may be more susceptible to some diseases. Epidemiologists monitor the health statuses of populations and develop medical treatments and disease prevention methods.

Over the years, biomedical research has made many contributions to our society. For example, the SARS-CoV-2 virus, which caused the COVID-19 pandemic, affected people all over the world. Researchers found out lots of important information about the virus, including symptoms and risk factors. Within 11 months, two effective vaccines were created, which saved millions of lives, and eventually allowed people to interact without masks again.

Looking ahead, developing better treatments for deadly diseases such as cancer and Alzheimer’s disease would definitely be top priorities. Researchers will continue to be mindful about their laboratory animals and remain ethical with their studies. For now, people can rest easy and live longer, healthier lives, with fewer worries about disease.

Bibliography

California Biomedical Research Association. "What is Biomedical Research?" California Biomedical Research Association, ca-biomed.org/wp-content/uploads/2020/08/FS-What-is-Biomedical.pdf. Accessed 3 Jan. 2024.

Cook, Nakela L., and Michael S. Lauer. "Biomedical Research COVID-19 Impact Assessment: Lessons Learned and Compelling Needs." National Academy of Medicine, nam.edu/biomedical-research-covid-19-impact-assessment-lessons-learned-and-compelling-needs/. Accessed 11 Jan. 2024.

"The Importance of Animal Research." National Association for Biomedical Research, www.nabr.org/biomedical-research/importance-biomedical-research. Accessed 1 Jan. 2024.

"What are In vivo, In vitro, and In silico Studies?" California Biomedical Research Association, ca-biomed.org/wp-content/uploads/2020/08/What-is-.-.in-vitro.pdf. Accessed 3 Jan. 2024.

"What is Epidemiology?" Rollins School of Public Health, sph.emory.edu/departments/epi/overview/what-is-epidemiology/index.html. Accessed 3 Jan. 2024.