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Bioengineering and Nanotechnology for Cancer Treatment

Biomedical engineering has only recently emerged as its own study. Much of the work in biomedical engineering consists of research and development with a broad range of subfields such as bioinformatics, biomechanics, biomaterial, nanotechnology, biomedical imaging, tissue engineering, genetic engineering, neuroengineering pharmaceutical engineering and rehabilitation engineering. The mission of biomedical engineering is to provide students with a solid foundation in engineering while offering in-depth exposure to the life sciences. This program aims to teach students how to apply engineering tools and approaches to solve problems in biology and medicine in order to advance the health care treatment system including diagnosis, monitoring, and therapy.Biomedical engineers work closely with life scientists, chemists, and medical professionals (physicians, nurses, therapists, and technicians) on the engineering aspects of biological systems. Bioengineering faculty members at George Mason University collaborate with colleagues at George Mason University and nearby institutions including Inova Health Center and federal laboratories such as the Naval Research Laboratory, the National Institutes of Health Clinical Center, and the National Institute of Standards and Technology.

The Biomedical Engineering Society (BMES), the American Institute for Medical and Biological Engineering, the Institute of Biological Engineering (IBE), the Institute of Physics and Engineering in Medicine (IPEM), and the National Institutes of Health (NIH) are some of the professional associations that biomedical engineers work with. These experts exchange their ideas and research works at various annual conferences such as BMES, Ultrasound Imaging and Tissue Characterization (UITC), Society of Neuroscience (SFN), Society of Photographic Instrumentation Engineers (SPIE). In fact, the BMES annual meeting is one of the largest and fastest growing events for the biomedical engineering fields and this year it is celebrating its 50th year anniversary.

Nanotechnology is one the most cutting edge topics currently being researched in the field of bioengineering. Its successful innovations in drug delivery systems (nanomedicine) has provided a lot of benefits to cancer diagnostic and treatment. Patients that were once given only one treatment option (systemic chemotherapy), now are choosing among safer and more convenient treatment options such as targeted therapy or thermal therapy. These approaches have been shown to improve the patient’s quality of life as well as their physical health.

*PubMed central, Web of Science, IEEE Xplore, BIOSIS* are among the bioengineering database sources that provide a wide range of scholarly articles. *Nature, Science, JAMA (journal of the American Medical Association), and Circulation* are some of the most influential journals in the field and significantly advance the scientific understanding. There are some trade publications and magazines such as *Photonics Spectra, R&D Magazine, Sensors, and MedicalLaboratory News* where the most recent innovations are introduced and advertised. Lastly, the Center for Disease Control and Prevention and the World Health Organization are grey literature sources in the biomedical engineering community which publish healthcare guidelines and discuss the recently discovered diseases. All mentioned sources were significantly helpful in retrieving articles for my research on alternative cancer treatment options.

Biomedical engineering publications incorporate a variety of research methods such as content analysis, case studies, experimental reports, and theoretical analysis to investigate a proposed approach. They normally start with quick background information about what has been done related to their topics and the current challenges associated with them and then try to pursue the problem from a different aspect. They always back up their theories with scientific knowledge; therefore, if the reader is not familiar with specific engineering or biological concepts, they might get confused. After that, they attempt to prove their theory or characterize their synthesized product by in vitro or in vivo experiments and generate some results. At last, the results would be analyzed and compared with previous findings and if additional improvement is needed, the authors would mention that as well.

 In the article “Novel Delivery Approaches for Cancer Therapeutics,” researchers from University of Missouri-Kansas City, Division of Pharmaceutical Sciences incorporated content analysis and case studies of treatment options for cancer patients in the United States. After reviewing the common causes of cancer development, the current treatment options and their side effects, the authors introduce targeted therapy as a novel therapeutic approach for cancer. They elaborated on the approach by dividing it into intracellular and extracellular targeted therapy and explored each category by bringing some case studies related to them. In each case study, the authors meticulously illustrate scientific methodology, experimental set up, and the observed results and compare them with previous studies.

Academic genres used in the biomedical engineering field are mainly in form of literature review and experimental report. These genres discuss published information in a particular subject area or present the experimental results for in vitro/vivo experiments. As a biomedical engineering student, I am often assign to write a proposal about the topic that I want do research on in the beginning of semester. The purpose of the proposal is mainly to show how a student attempts to tackle the problem and what type of sources will be used to support their approach. Both students and experts in biomedical engineering are expected to provide background information on their research topic, as well as explain why it is important to dedicate time to solving the problem, and provide possible solutions.

While working on this project, I realized how broad my field is and how many different approaches have been developed to replace systemic chemotherapy for cancer treatment. The patient’s quality of life is among the most important aspect of their treatment, yet it is often neglected by the doctors. It is important to develop safe and novel method for treating cancer so that patient will suffer less both physically and mentally.