

Thesis Portfolio

Decision Support System for Radiation Oncology

(Technical Report)

Impact of Technology on Biology and Physiology

(STS Research Paper)

An Undergraduate Thesis

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Kelsie Reinaltt
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Department of Biomedical Engineering

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Sociotechnical Synthesis

Technology, such as artificial intelligence, has benefited society with its precision, accuracy, and speed across many industries. Artificial intelligence has recently been introduced in to the field of healthcare, with experts looking to improve the process by which medical treatments are decided. The motivation for the technical project is to integrate artificial intelligence into radiation oncology treatment decision-making process. While such technology has been essential in providing the resources needed for mankind to survive and thrive, it has also been the reason for human suffering and hostility. More specifically, technology, related or unrelated to biotechnology, has the potential to threaten the biology and physiology of an organism. Many non-biological technologies have been exploited with the intent of causing biological damage, but this does not fit the exact characteristics by which bioterrorism is defined. The purpose of this science, technology, and society (STS) research paper is to investigate how technologies out of the biotechnology realm have had a negative impact on human biology and physiology. Each technology reviewed in this analysis is evaluated for its success as a technological fix along with its unintended consequences, and the politics behind the technology. Upon completion of the decision-making software with artificial intelligence, healthcare providers will be able to understand treatments and more confidently help their patients select the ideal treatment plan. The analysis of how non-biotechnologies impact biology and physiology will encourage scientists and engineers to consider the potential exploitation and ethical implications of tools and technologies they develop.

Currently, medical physicists and dosimetrists develop radiation treatment plans using software and powerful calculations after a radiation oncologist prescribes the treatment volume and dose (Radiology (ACR), n.d.). The introduction of an algorithm which develops treatment

methods and outputs the most promising plan iterations would increase the amount of treatment plans that can be considered. Furthermore, an algorithm may reduce human error, and quantitatively identify the most suitable treatment strategies. The proposed project focuses on the development of visualization tools to aid doctors in selecting the optimal treatment plan using the proposed algorithm. The goals of this project are to deliver a CT image viewer along with an interactive radiation line graph, and a radar chart that allows for the visualization of dose modification tradeoffs in different regions of interest. Such a tool would enable medical physicists, dosimetrists, and oncology doctors to better understand differences between treatment plans and visualize such differentiations in three dimensions as opposed to two dimensions. With an improved understanding of each treatment plan, health care providers can consider non-medical and non-quantitative factors, such as values and finances, when helping patients select a plan that best fits their specific situation.

Bioterrorism is defined as the use of biological weapons potentially in the form of living organisms to cause illness or death (Danciu, 2011; Jansen et al., 2014). This strict definition does not consider the significant effects a non-biology based technology can have on biology or physiology. To demonstrate its effects, three different technologies were analyzed; the September 11 attacks, the atomic bomb, and the sonic attacks allegedly leading to Havana Syndrome. Each technology was analyzed using technological fix and political technology as guiding frameworks. The results of this study shed light on how a technology initially unrelated to biology and physiology can come to influence human health. Understanding the potential health effects of a technology will enable its users to be more responsible and conscientious, and will prompt engineers to carefully consider the potential developments of their technologies on health and safety.

The artificial intelligence treatment planning with visualization tools project being done concurrently with the investigation non-biological technologies' effects on biology and physiology prompts the question of whether the integration of artificial intelligence in medicine is valuable and responsible. For this particular project, the advantages of artificial intelligence integration seem to outweigh the disadvantages, but does not dismiss the possible drawbacks and risks. Some of the main concerns in the integration of artificial intelligence in medicine are the unforeseen consequences and human biases, and algorithmic bias. The use of data, patient privacy, and cybersecurity are also some concerns of introducing artificial intelligence in medicine, as medical data is sensitive in nature. Working on both projects at the same time has moved the project team to consider such concerns and how to defend technology, the data used, and the people affected. Reflecting on the future implications of the technical project and STS research paper conclusions of the has also made clear the impact of technology developed by engineers and the responsibility engineers have to society.

Work Cited:

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