Building Transparency in the Scientific Community

STS Research Paper

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On my honor as a University Student, I have neither given nor received authorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

Signed 

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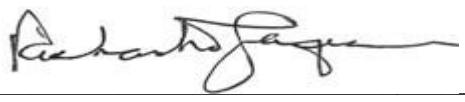
Signed  Date 08 May 2022

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Introduction

Bioengineering and biomedical research has led to an evolution in healthcare, treatment, and increased life expectancy over the last century. The scientific community has been immensely successful in discovering new diseases, developing vaccinations and preventative medicine, and increasing the quality of life for individuals via functional prosthetics, medical devices, implants, plastic surgery, and more convenient technology. There is an ever present need to develop new therapeutics and diagnostic tools for diverse infectious and chronic illnesses, as well as increase the quality of medical care in clinical settings. However, the availability of treatments and care on the market does not necessarily translate to equal access for all Americans. Nor does this mean that the average individual has unwavering faith in the scientific community. This research paper will focus on transparency and ethical issues in the scientific community, specifically in biomedical engineering research, and how they can be resolved.

Type 1 Diabetes and New Technology

Type 1 Diabetes is a chronic autoimmune illness that results in afflicted people not being able to produce the proper levels of insulin in the body to restore a normoglycemic state throughout the day. As a result of insufficient insulin being produced, glucose levels remain too high, which results in damage to internal organs and blood vessels, leading to long-term effects such as cardiovascular illnesses. The monthly cost of externally released (exogenous) insulin treatments is approximately $1,500, and with the average household monthly income in America being just upwards of $4,000, this life-sustaining medical treatment puts a strain on millions of Americans.[1] Close to 25% of individuals with diabetes choose not to purchase insulin as a result of the financial burden.[2] Diabetic care also requires constant monitoring to ensure symptoms remain steady, and not everyone has the ability to be supervised at all times, especially young children and adolescents, and elderly people with additional symptoms. Alternative diabetic treatments include beta cell transplants, however this treatment arrives with its own plethora of flaws. Transplants are

not always integrated into the body, due to the need to match with a patient's immunocompatibility and the high probably of islet cell mortality.[3,4] Actually receiving beta cells for the procedure has proven to be very difficult since cells need to be retrieved from live, functioning pancreas. Further, patients need to continue to take immunosuppressants for the duration of their life to ensure the transplant remains functional. Therefore, this emphasizes the need for a therapeutic for Type 1 Diabetes that will restore endogenous insulin secretion in an affordable, safe, and effective manner.

My Capstone research project centered around encapsulating insulin-producing beta cells in a microporous annealed particle (MAP) hydrogel for the purpose of restoring endogenous insulin secretion.[5–7] The purpose of using this particular novel gel, patented by the Griffin Lab, is because it acts as a medium that will reduce inflammatory responses and not require any type of immunosuppression, mitigating the immunocompatibility complications of beta cell transplants. It is also intended to be a one-time treatment, as opposed to the daily doses of insulin that remain an expensive inconvenience. In essence, we are creating a mini-pancreas that will ideally cure the physiological problems of diabetes.

Our team has made a number of successes with our treatment over the course of this past year, and we hope to soon move on to preclinical trials with mice, though there remains an issue. However, if this treatment passes preclinical trials and makes its way to human studies, would people want to receive this treatment? Do people find beta cell transplants to be ethically sourced? Would this opinion change if the beta cells were stem cells or or underwent reprogramming? Would people be hesitant because the treatment is not "natural"? Even if it passes FDA regulations, and checks off all the boxes, would diabetic individuals trust this new therapeutic? How would we convince people that this method would be more effective and beneficial despite insulin has been the leading diabetic treatment for the past 20 years? In a grander scope, are people willing to receive treatment without fully knowing the composition of the therapeutic or the potential range of long-term side effects for the possibility of recovering from or better managing their condition? How can we mitigate and resolve these concerns?

Methodology

The data for this project mainly focuses on collecting peoples' opinions of the COVID-19 vaccines in response to the SARS-COVID 19 pandemic, and what factors contributed to whether individuals received and/or trust the treatment. I deliberated some of the most common concerns and questions, as well as some popular myths, about the novelty of the vaccine and studied how these were founded, and which particular groups of people thought similarly. Education level was the main variable studied when making conclusions and drawing connections between similar trends. I also examined what measures the scientific community was taking when the vaccine was newly released to ease minds and educate the population.

Education and Trust in the Scientific Community

As of December 28, 2021, when adults 18 and older were asked why they did not receive the vaccine, 35.4% said they did not trust the government, 49.6% said they were concerned about possible side effects, and 42.4% said they did not trust the COVID-19 vaccines.[8] Only 1.7% said were concerned about the cost or it was difficult for them to access the vaccine. As a result, a sweeping majority of the lack of vaccinations was not an issue of accessibility or financial coverage, but choice. Why did people feel this way? Why did they lack trust? Of the people surveyed, 23.3% of people said they didn't know whether the vaccines would protect them, and 31.8% said they didn't think they needed a vaccine. This is already telling that this population of people is uninformed about the composition of a vaccine and how exactly they work. However, this is not necessarily the fault of the people. Another study conducted in August of 2021 examined the number of people who received at least one vaccine dose, categorized by race, age, gender, and education level. 66% of people who had a high school education or less had received at least one dose of the vaccine, but this number increases to 81% with a college degree and a whopping 89% with a postgraduate degree.[9]

These statistics are not to say that there has not been sufficient research on the COVID-19 vaccines. A plethora of papers have been published since mid-2021 regarding the efficacy of the vaccine, how it

reduces transmission of the virus, and why the boosters are necessary and effective.[10–16] Review articles have also been published for the purpose of summarizing the known vaccines, their chemical compositions, how they function, reported side effects, and their respective efficiencies.[17] Of 180 cases of SARS-CoV-2, 8 came from the vaccinated group and 172 came from the placebo group, indicating a 95% effectiveness at preventing COVID-19 infections. These papers can be accessed by the public, and thus, available to all. Data is, indeed, being shared by the general public, but only once sufficient evidence has been collected to draw proper conclusions and avoid misinformation spread by people who are not well-informed.

The conclusion I drew from this research is that there is a massive disconnect between the general public and the scientific community. The people share concerns about the vaccine and worry for their safety, and scientists have proven without a doubt that the vaccines are an effective method of reducing the dangers of COVID-19, and yet people remain unvaccinated. There is a plethora of information available for people to learn, but it may not be written in a manner digestible for people without backgrounds in college-level biomedical sciences, immunology, or chemistry, which is a large majority of the American population. Scientific terminology can sound dangerous, especially when one hears about "adenoviruses", which is, ironically, a type of vaccine, and fears that the vaccine will make them even more sick. People without a research background conducting their own "research" can also lead to some detrimental consequences. Raw, uncorrelated data may provide fuel for someone to create their own unsubstantiated conclusions, such as the idea of the vaccine killing an individual when it was due to a fluke allergic reaction. When you factor in different social media sites like Facebook, Twitter, and Instagram, popular platforms for communicating ideas, the spread of misinformation is catalyzed astronomically.

The Ethical and Societal Implications of Biomedical Engineering Research

Because I have hopes of earning my doctorate in biomedical engineering and entering the field of academia, empathy and compassion are integral components I need to consider for the welfare of people I will help in the future. For any type of biomedical treatment, it is crucial for there to be the utmost

transparency between the clinician or scientist and the patient. This ensures peace of mind for the patient and reassures care in the relationship between the two people.

If any therapeutic is translated to clinical use in the future, a number of questions are to be considered. Who will be the first people to receive treatment? Would it eventually be available for the global population? How can we ensure distribution will not be motivated based on age, gender, socioeconomic status, or ethnicity? What price would the therapeutic be set at? Would this cost be the same internationally? We would need to ensure that distribution of the treatment remains fair and moral for all patients because the entire goal of biomedical research and innovating new treatments is to help as many people as possible. Another significant health disparity to be considered is the availability of treatment materials and proper infrastructure. Less developed healthcare systems might lack the accessibility or equipment to create advanced treatment, which means that there will still be some people without access to a therapeutic that other people are fortunate enough to take advantage of. Ethical and moral concerns like these motivate me to carefully consider these factors for future projects and clinical applications.

Conclusion

The foundational basis of medicine is to treat people with illnesses and improve their quality of life. However, it seems that with the explosive progress of research and the credibility scientists gain from making peer-reviewed discoveries, it's possible that that perspective can get a little muddled. Researchers become more focused on developing something before any of their colleagues in order to be bestowed fame and prestigious honor. Meanwhile, the individuals that these scientists have promised to help remain uninformed, uneducated, and unable to understand the science that is supposed to save them. In the future, we need to apply a bigger importance on ensuring that the population has a general understanding of the medications they're taking, the vaccines they're receiving, and any type of treatment they undergo. It is immoral to neglect helping people understand science when some individuals are not given the opportunity to attend college or continue schooling. We need to focus on connecting the gap between science and humanity and remember the principles on which medicine was founded.

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