ISSN: 2755-0125

Journal of Virology Research & Reports

SCIENTIFIC Research and Community

Review Article

Open Access

An Analysis of Vaccine Research, Development, and Distribution with Specific Focus on Covid-19 Vaccine Information and Development

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ABSTRACT

Given the immediate circumstances of the looming Covid-19 pandemic, now more than ever it is important for vaccinations to be given and received. Far from the celebration that a vaccine for this deadly disease should have received, there is more controversy surrounding the creation and administration of lifesaving covid-19 vaccines than was ever expected. Whether a continuation of administrative disdain for the vaccine or push back based on actual health consequences, an age of precaution and hesitancy has been ushered in surrounding vaccine utilization. To better observe this concept, one must first understand the root of vaccine hesitancy, one avenue of which stems from the use of stem cells in the production and manufacturing of vaccines. Once familiar with the concept of stem cell use and vaccine production a closer look must be taken into specifically the use of stem cells in the current production of the covid-19 vaccine, given the huge backlash it has received in the public and media. From here, a broader explanation of anti-vaccination narratives was analyzed, concentrating on the three main defenses for these stances. Following this analysis, a comparative of the three common vaccines available on the market, Moderna, Pfizer, and Johnson & Johnson, including their performance in human trials and efficacy studies is discussed. This article focuses on identifying the foundation of vaccine science while offering a descriptive explanation of Covid-19 vaccination research completed.

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Received: March 10, 2022; **Accepted:** March 15, 2022; **Published:** March 25, 2022

Keywords: Covid-19, Vaccine, Moderna, Pfizer, Johnson & Johnson, Stem-Cells

Abbreviations

US (United States)

Introduction

With 770,890 deaths and counting attributed to Covid-19 in the US, it would have been assumed that a frenzy would have formed upon Covid-19 vaccination release to see who could be first in line [1]. With this thought in mind, officials took the time to lay out a tiered vaccination plan allowing front line workers and those most at risk for a Covid-19 infection to receive the vaccine first followed by various phases of the general population [2]. While a shortage was prepared for, what researchers weren't prepared for was the tremendous backlash seen by the general public over the production and administration of this vaccine in particular. Although shortages were seen, a large portion of Americans felt uncomfortable with the timing, research, and government backing of this new vaccine. Given the administrative backing, or lack thereof, of this vaccine and pandemic precautions in general, it was not hard to see why many Americans felt confused or uncomfortable with the brutal push for vaccination. Considering this, it seemed that many government bodies defaulted into an authoritarian perspective on vaccination rather than leaning into the education needed to create a level of comfort among the population of what was entering their body and why it was so useful. Like how the argument "because I told you so" does not work for many parents, the US government and health organizations quickly saw the repercussions of this vaccination response and intense encouragement, as more Americans decided against vaccination. Emboldened by ignorance among government officials, many individuals with harmful anti-vaccination agendas were able to capitalize on the power created in the disdain for mandated vaccination and could therefore spread these messages throughout the media easily and effortlessly. Unfortunately, the creation of this detrimental echo chamber meant the public was now leaning into the opinions with expert backing, silencing the voices of healthcare workers and scientists who fought so hard to keep the pandemic at bay and provide solutions to prevent rising deaths in the US. Seeing this unfold, a clear analysis of vaccine production, resistance, and attainable solutions as needed. This paper serves to highlight the roots of vaccination hesitancy and resistance, provide education on the Covid-19 vaccine development and its importance.

Discussion

Vaccinations: What are they and how are they Made?

A vaccine is a medical tool developed to be injected into the body and serves as a precursor of viral/bacterial defense that launches the body's immune response into making tools useful for fending off a looming illness. This process first began with William Jenner's inoculation of Cowpox viral particles into a small boy that then allowed him to be unaffected by the larger

smallpox disease that plagued early mankind. A lucky guess, the cowpox virus was close enough to the smallpox virus to elicit an immune response that better equipped his body to handle smallpox viral particles. Louis Pasturer continued research into vaccination, discovering several more types of vaccines that didn't involve infection by live virulent infection [3]. While several vaccination types exist, this article will focus mainly on the development of mRNA vaccines, a newer type of vaccine with a promising future. Regardless of vaccination type, all vaccines follow the same path of development to be introduced to the public as a safe and usable resource for protection. Early on in this developmental outline, there is a determination of vaccine ingredients, including the isolation of the pathogen strain in question and the immunogenic compounds that will be used from those pathogens. Arguably the most important ingredient in a vaccine is the antigen or portion of the virus that will prompt an immune response in the body to create mechanisms of protection against the virus. Antigens range from just pieces of the virus or could be defined as the entire virus itself in a nonvirulent form. Next in the vaccination mix is a stabilizer that prevents the vaccine from breaking down in the bottle. Surfactants serve similarly to stabilizers, making sure the vaccine stays mixed up without clumps or gradients of ingredients forming. Residual components could precipitate after manufacturing but will only be present in trace amounts, much like there are wheat and nut traces present in many of our foods. The last 2 ingredients are less often included in manufacturing and are instead added before the vaccine dose is administered. Dilution liquids, often sterile water, are used before giving the proper dose to a patient to ensure the right amount of vaccine components are entering the body. The last possible ingredient in vaccines is adjuvants, which serve to enhance the immune response of the body to the vaccine by initiating local immune responses near the vaccination site [4]. Once a vaccine has been created and contains an ingredient profile like the one above it must go through a rigorous testing process. It should be noted that the rigor of a testing process is not necessarily enhanced by time, meaning one vaccination's development time may be shorter than another if more resources and testing centers were available for the vaccine's development. Most important in this is the beginning step of selecting an antigen that correctly prompts the desired immune responses within the body. Mentioned briefly above, this can take multiple tests and is the foundation of vaccine development. Without obtaining and following this step, there is no hope for the vaccine to serve as a useful tool against illness. Once the antigen that will be used has been proven in the lab to elicit the desired immune response, the vaccine is tested on animals in the lab to ensure a limited number of undesirable results coincide with vaccination. Moving forward, the vaccine is ushered into a three-phase system of human clinical testing to continue testing the safety and efficacy of the vaccine. The first phase involves the vaccination of small numbers of young, healthy volunteers to determine the best dosing recommendations for the public and to continue to observe the safety of the vaccine. The second phase involves a control group of individuals as well as a vaccinated group of individuals to make comparisons of the vaccine's effects versus normal human fluctuation in health. These groups of volunteers are often very similar to prevent confounding variables from altering observable outcomes. Phase three of vaccine development is like phase two but much larger and spans across all different people types to ensure all populations can benefit from the vaccine. Phase two and three trials are conducted blindly, meaning one group will get the placebo of the vaccine and the other will receive the vaccine and no one in the study including scientists will know which person received which dose. These results are revealed at the end of the study to be compared with the findings observed [4].

History of Stem Cells in Vaccine Trials

One area of controversy within vaccine development and research is the use of stem cells in vaccine trials. Stem cells have long been used in the development of medical technology and serve as an important piece of legitimizing these technologies for use in humans. These stem cells come from living human tissue and are then able to be studied in the lab to determine the reaction between developing vaccinations and the human body. A much safer practice than using human test subjects and a much more accurate way of testing as compared to animal testing, human stem cells have been used over the years to produce many vaccines and other treatments [5]. Although very helpful in research and development, stem cell use has infamously gathered criticism from some for various reasons. Among these reasons are those who attest to abortions on religious standings and therefore see stem cell use, much of which was learned about and began from taking cells from aborted fetuses, as immoral. While this may be a legitimate concern for some, it is important to note that the fetal cells used in the creation of many vaccinations come from fetal cells that have been grown in the lab, not from current aborted fetuses. The cells do draw their initial lineage to the original 2 fetuses used, but since then scientists have been able to grow fetal cells in the lab without utilizing aborted fetuses anymore [5]. Some critics also seem to be wary of the assumption that vaccines can somehow alter a person's DNA due to the use of these stem cells and the DNA that they individually hold. This idea is not correct as all cellular debris, including DNA and any DNA altering mechanisms, are washed away from the viruses grown within the cells to make the vaccines [6].

Covid-19 Vaccination Information and Development

The Covid-19 vaccine has made waves in the scientific community as one of the first vaccines used that utilizes the virus's mRNA to cause an immune response in the body. This technology utilizes a virus's ability to create proteins that trigger immune responses in the body. The mRNA, or instructions from the Covid-19 virus, are placed into the body through the vaccination. These instructions then tell muscle cells to begin creating the spike protein present on the covid-19 virus. Once these proteins are created, the body recognizes them and mounts an immune response. Beginning here, the body creates defense mechanisms against the virus without being infected with the part of the virus that causes damage. Soon after the body breaks the mRNA down, as mRNA is very unstable and is easily broken down and gets rid of the spike proteins [7]. With this technology utilized, the more people vaccinated against Covid-19 will lead to a decrease in those contracting the disease as people's bodies will contain the tools needed to fight off the virus before it can take hold. When fewer people are contracting the virus, it can be spread much less and therefore is less of a threat.

It seems some common themes stand in the way of the importance of vaccination due to the lack of education of the public on assumed issues with the vaccine. While the covid-19 vaccine development research does utilize fetal cells to prove the function and mechanism of the vaccine's efficacy, both the Pfizer and Moderna mRNA vaccines do not contain any stem cells once manufactured [8]. Therefore by partaking in vaccination, that does not mean that fetal cells were used in that vaccine or anywhere in the manufacturing of that vaccine. While fetal cells are often used in the lab in the development of these vaccines, these cells are far from the final product of vaccinations.

Also worth noting is the common idea that the vaccine doesn't work because someone may have contracted Covid-19 even after receiving the vaccine. A vaccine does not prevent someone from contracting the disease but allows the body to fight off the virus before it can monopolize within the body and cause damage. Even if the virus is still contracted after the vaccine, the body will be more prepared to attack it and therefore the infection will most likely be less lethal [9].

Conclusions

There is a certain discussion that needs to be had when regarding the unique situation the Covid-19 pandemic has created. While we all reserve our right to decision-making and to have freedom within our beliefs, there comes a point when a decision must be made about affecting the health of others. When freedoms begin dictating the lives of others and putting others at risk, that is when these decisions should be held at a higher degree of discrepancy. With this, it is important to offer the public the education and discussion necessary for them to feel empowered and comfortable enough to decide on receiving a vaccine. This paper attempts to cover topics often washed over within the scientific community, hopefully breaking down some of the walls between vaccine importance and the wariness of vaccine science within the public.

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